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CEREBRAL APOPLEXY

SURGICAL TREATMENT OF INTERNAL CAROTID OCCLUSION

By J. RIISHEDÉ, P. OTTOSEN and
T. SØNDERGAARD

A sudden catastrophic onset of symptoms was noted in 35 per cent of 107 patients with internal carotid occlusion surveyed by Johnson & Walker (1951). The occlusions were unexpected findings in patients suspected of having intracranial tumours.

In 300 consecutive patients with cerebral apoplexy admitted to the Department of Neurosurgery, Aarhus, from 1951 to 1957 and studied according to the principles previously accounted for by Riishede (1957), two patients had occlusion of the common carotid, and 65 of the internal carotid artery. In 58 of the 65 patients the internal carotid occlusion was located near the origin of the artery. Thus, in 60 out of the 300 patients, *i. e.* in 20 per cent, the apoplectic seizure was caused by extracranial occlusion of the carotid system.

Strully & al. (1953) first attempted surgical reconstruction of an occluded internal carotid artery. Since then, surgery has been carried out in a considerable number of patients, resulting in many disappointments and few successes.

Until the time of this report the largest series of patients operated on for this condition was published by De Bakey, Crawford & Fields (1959).

The present report is based on a total of 34 carotid arteries in 32 patients with cerebral apoplexy, operated on for carotid occlusion.

CLINICAL FEATURES

According to the original principles of selection, reported by Riishede (1957), only patients above 40 years of age were included. Six patients were from 40 to 49; 14 from 50 to 59; and 12 from 60 to 69 years of age. Twenty-four patients were men, eight women.

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Fifteen of the 32 patients had right-sided, 13 left-sided, and 4 bilateral occlusion. Two patients in this last category were operated on bilaterally. Thus a total of 34 carotid arteries were subjected to surgery. In two of these 34 arteries the occlusion was found in the common carotid. The remaining 32 had internal carotid occlusions which in three instances proved to be intracranial.

A hemiparesis — generally more marked in the upper than in the lower extremity — was encountered in all but four patients. One of these four only had a deep hyperreflexia, another with bilateral carotid impairment had paresis of both legs. In the remaining two patients the paresis was restricted to the upper extremity. Aphasia was associated whenever the dominant hemisphere was involved. The visual fields could be tested in 19 of the patients. They were unrestricted in 12, while a homonymous hemianopia ipsilateral to the hemiparesis was disclosed in the remaining seven.

The onset of the attack was acute or subacute. Initial impairment of consciousness was noted in half the patients. In most instances it was characterized by somnolence, which decreased somewhat during the first hours or days following the attack. Initial sopor was noted in four patients. They were operated on within the first 24 hours following the attack and no improvement of consciousness was noted in this period. Coma was never an early symptom.

Intermittent cerebral symptoms are, generally, considered typical of carotid insufficiency. In the present series 15 patients had no history of cerebral symptoms previously, and only seven had more than one previous episode referable to the demonstrated carotid disease. These brief attacks occurred over periods ranging from five days to three years. A single previous attack was noted in the remaining 10 patients, occurring from eight hours to one year prior to the seizure leading to operation.

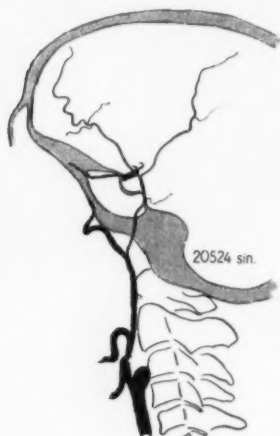


Fig. 1



Fig. 2



Fig. 3.

Patient No. 24. Extracranial Blocking of the Internal Carotid (Fig. 1) with Filling of the Cerebral Arteries via Orbital Collaterals (Fig. 2, late Exposure). Normal Angiogram one Month Following Operation (Fig. 3). Complete Clinical Recovery.

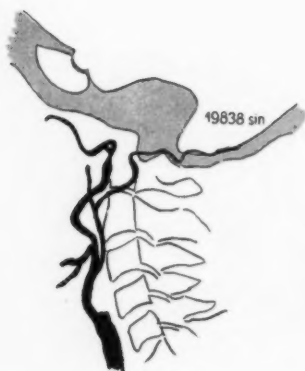


Fig. 4.

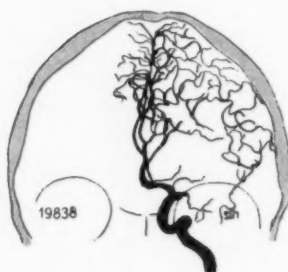


Fig. 5.



Fig. 6.

Patient No. 17. Occlusion of the left Internal Carotid at its Origin (Fig. 4). Angiograms 18 Days after Operation (Figs 5; 6): Internal Carotid Circulation Restored, but Occlusion of the Middle Cerebral. No Clinical Improvement.

Normal blood pressure was found in 15 of the 32 patients, the lowest value being 110/65 mm Hg in a single patient. A slight or moderate arterial hypertension with a diastolic pressure at or below 100 mm Hg was seen in 15, and only two had hypertension with a diastolic blood pressure over 100 mm Hg — 105, and 120, respectively. In one patient the systolic pressure was measured to 90 mm Hg in the arm ipsilateral to the occluded common carotid artery, and to 170 mm in the contralateral arm. This suggests an associated impairment of the blood flow through the ipsilateral subclavian artery.

Severe heart disease was diagnosed in four patients. Patient No. 17, a man of 66, had had

a coronary occlusion four years previously, associated with a transient left hemiparesis. Two later cardiac attacks were unassociated with cerebral symptoms. His death one month following restoration of the left internal carotid circulation was caused by a myocardial infarction. Patient No. 25, a 68-year-old man, died 36 hours postoperatively from coronary occlusion, probably provoked by a prolonged drop in blood pressure — from 180/90 to 90/75 mm Hg — during operation. Patient No. 26, a woman of 68, had for several years had arterial hypertension and dyspnoe on effort. Electrocardiogram revealed auricular fibrillation, and a chest X-ray considerable enlargement of the heart. In patient No. 29, a

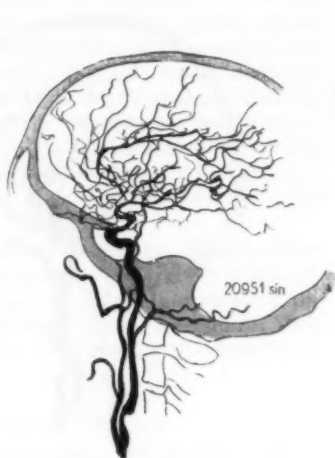


Fig. 7.



Fig. 8.

Patient No. 28. Subtotal Occlusion at the Origin of the Internal Carotid (Fig. 7). Normal Angiogram 12 Days after Operation (Fig. 8). Complete Clinical Recovery.



Fig. 9.



Fig. 10.

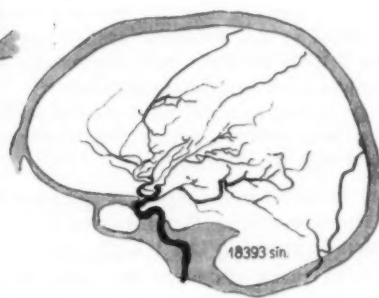


Fig. 11.

Patient No. 6. Subtotal Occlusion of the left Internal Carotid (Fig. 9). Seven Months after Operation: Internal Carotid flow Restored (Fig. 10), but poor Circulation in the Anterior and Middle Cerebrals (Fig. 11). Some Clinical Improvement.

women of 65, signs of degenerative heart disease were even more marked. This patient had for seven years been incapacitated because of angina pectoris and arterial hypertension.

ANGIOGRAPHICAL FINDINGS

For arteriography a 45 per cent solution of Hypaque was used. A device for seriography was not available for the present series of patients. Three films were exposed in the lateral, and two in the frontal view by manual exchange of the plates. A total of 77 carotid angiographies was made in the 32 patients, and 25 of these were examined bilaterally. Only one angiographical complication was noted. The patient, a man of 60, had injection performed into the common carotid artery on the right side — the side of the

internal carotid occlusion. This provoked a drop in systolic blood pressure from 130 to 90 mm Hg and a drop in pulse rate to 48. He was awake before the examination but appeared confused and slightly somnolent afterwards. The following day a left-sided carotid arteriography showed a patent internal carotid, however a cerebral arteriogram with slight atherosclerotic changes. The same day a blocking atheroma and a thrombus were removed from the right internal carotid, and a moderate backflow was obtained. The pre-operative impairment of consciousness increased post-operatively, and the patient died three days following operation. Autopsy revealed a partial thrombotic occlusion of the right internal carotid, a thrombotic blocking of the right middle cerebral and a corresponding infarction of the cerebral

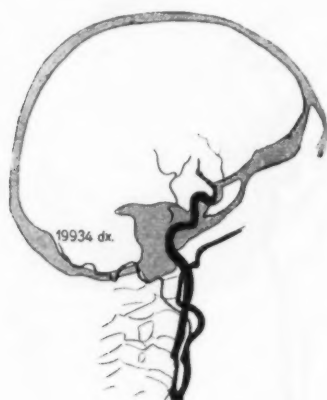


Fig. 12.

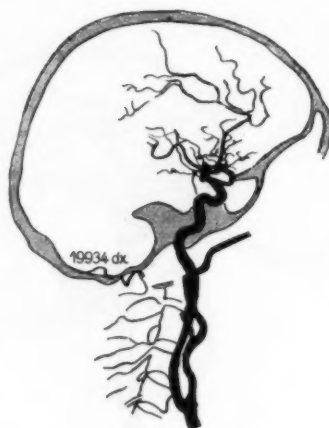


Fig. 13.

Patient No. 21. Subtotal Occlusion of the Origin of the Internal Carotid (Fig. 12). 4 Months Following Operation: Circulation Restored, but poor Filling of Internal Carotid Branches (Fig. 13).

hemisphere. Furthermore a recent, partially occluding thrombosis of the origin of the left internal carotid artery was noted.

In one of the two patients with occlusion of the common carotid, injection into this artery resulted in filling of the vertebral system via the subclavian artery. In the other patient the artery was solid, and no injection possible.

The instances of internal carotid occlusion may, according to the angiographical picture, be divided into three groups:

1) In 21 arteries there was complete holding-up of the dye within the proximal 2—3 cm of the internal carotid (Figs 1 & 4).

2) In three instances the same blocking was seen on the first film, but on late exposure a fine

streak of dye could be traced to the base of the skull, but not intracranially.

3) In eight arteries the blocking was partial, and varying degrees of intracranial filling by the normal route was visible (Figs 7; 9; 12; 14).

In the first group the external carotid artery contributed in six instances to the cerebral circulation. Only the orbital type of collateral circulation was represented. This circulation gave rise, in four of the six instances, to varying degrees of filling of the middle cerebral, but always with a considerable delay. Collaterals from the external carotid system were never disclosed in the remaining two groups.

The contralateral angiography, made in 25 of the patients, demonstrated that a blocking of one

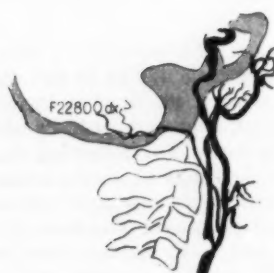


Fig. 14.



Fig. 15.

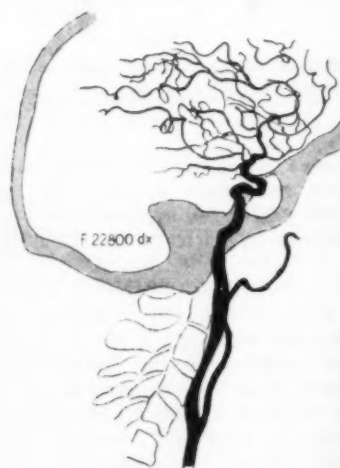


Fig. 16.

Slight Clinical Improvement.. Patient No. 30. Pre-operative Angiograms (Figs 14; 15) with Subtotal Extracranial Internal Carotid Occlusion. Normal Angiogram one Month after Operation. (Fig. 16). Some Clinical Improvement.

internal carotid artery is frequently associated with atherosclerotic changes in the other, or in its branches. Only eight of these 25 patients had a normal angiogram on the side contralateral to the occlusion. Three had signs of slight, and seven of more severe diffuse changes in the cerebral branches. In three patients the siphon showed a localized narrowing to about half the normal size, and the remaining four had bilateral internal carotid occlusion.

A basal collateral circulation was demonstrable in 16 of the 25 patients. Varying degrees of filling, from this circulation, of the middle cerebral on the side of the occlusion was visible in 10. This filling was, however, angiographically normal in only two patients.

SURGICAL FINDINGS

Under general anaesthesia the carotid arteries were exposed through an incision from the ma-

stoid to the clavicle along the anterior border of the sternocleidomastoid muscle. Frequently the region of the bifurcation was embedded in solid connective tissue and had to be exposed by sharp dissection. A longitudinal arteriotomy of the adjoining parts of the common and internal carotid arteries exposed the blocking lesion. The atheromatous plaque was removed by a blunt dissection endarterectomy. The artery was next cleaned of thrombi and clots by suction through a polyethylen catheter, introduced to the base of the skull. The arteriotomy was closed by simple suture. Grafting with Ivalon and homotransplant was used in two patients, however with negative results.

The most common finding was an atheroma localized within the proximal one to two centimeters of the internal carotid artery. An atheromatous lesion blocked the artery completely in four instances, while in 15 a small residual lumen

Table I.

A Satisfactory (Spurting) Back-flow was Obtained in 13 Arteries (i. e. 12 Patients, all Men). In the Upper five there was no Intracranial Filling Through the Internal Carotid. The Lower Eight had Subtotal Internal Carotid Occlusion with more or less Intracranial Filling Through this Artery.

Number	Age	Interval between attack and operation	Angiographical control	Clinical result
3	54	one day	One hour postop.: Total blocking.	Death 3 days postop.
17	66	9 days	18 days postop.: Flow restored. Non-filling of middle cerebral.	Unchanged. Death 1 month postoperatively from myocardial infarction.
24	56	6 hours	1 month postop.: Normal angiogram.	Complete recovery.
27	66	14 hours	Not performed.	Unchanged. Death from pneumonia 2 months after operation.
32	64	one day	Not performed.	Death 1 day after operation. Autopsy: Thrombotic occlusion of internal carotid and middle cerebral.
5	57	8 days	Not performed.	Unchanged. Death 6 days after operation. Autopsy: Thrombotic occlusion from aorta to siphon. Cerebral infarction.
6 (left)	54	14 days	7 months postop.: Flow restored. Poor filling of the middle cerebral.	Improved.
6 (right)	54	6 days	Not performed.	Suppurative destruction of internal carotid. No improvement.
15	54	months	Not performed.	3 months after operation: Complete recovery.
21	66	10 days	4 months postop.: Flow restored. Poor filling of anterior and middle cerebral.	4 months postop.: Slight improvement.
25	68	10 hours	Not performed.	Death 36 hours after operation: Autopsy: Cerebral infarction, no occlusion. Myocardial infarction.
28	66	19 days	12 days postop.: Normal angiogram.	4 months after operation: Complete recovery.
30	44	20 days	1 month postop.: Normal angiogram.	2 months after operation: Improved.

in the atheroma was blocked by thrombotic masses. Cranial to the atheroma the artery was packed with clots of varying age and consistency. Atheromatosis extending beyond the proximal one to two centimeters of the internal carotid was found in three instances in which the whole extracranial portion of the internal carotid (two instances) or the entire common carotid (one instance) were transformed into solid calcified and atheromatous cords. These three patients were operated on 16 hours, two days and 11 days, respectively, following their initial attack. The entrance to the external carotid artery was slightly narrowed by the atheroma in a few cases; however the artery was always patent. A purely thrombotic occlusion — of varying age and appearance — was found in eight arteries. Three arteries were of so small a calibre that the presence of a primary hypoplasia is most likely. One of these arteries, in a patient with a poorly developed circle of Willis, was patent although the lumen was hardly passable for a catheter with an outer diameter of three mm. The two other arteries were of similar size, however without lumen. Finally, two arteries were normal extracranially. They belonged, arteriographically, to group 2, and the blocking was intracranial.

A satisfactory back-flow from the cranial end of the internal carotid artery is an absolute prerequisite for restoration of circulation. Only a powerful and spurting backflow can be considered satisfactory. This was obtained in 13 arteries. These included the eight arteries constituting the group with partial blocking (group 3), which were operated on from 10 hours to several months following the attack. Only one was operated upon within the first 24 hours. The remaining five of the 13 arteries with spurting back-flow belonged angiographically to group 1 with complete holding up of the dye. Four of these were operated on within the first 24 hours following the attack (Table I).

A less satisfactory back-flow, oozing, but not spurting, was obtained in six arteries. Four belonged to group 1, and were operated on from 36 hours to nine months after the attack. Two belonged to group 2, and operation took place within 24 hours following the apoplectic seizure.

In the remaining 15 arteries no back-flow could be obtained. Fourteen belonged angiographically to group 1 and one to group 2. Only three were operated on within the first 24 hours after the seizure.

RESULTS

It appears from the diagram (Table I) that a restoration of the internal carotid arterial circulation was obtained in seven of the 13 arteries where a satisfactory back-flow was seen. This was controlled by autopsy in one patient, and in six by angiography performed from 12 days to seven

months following operation. Angiographical control was not obtained in patient No. 12 who had signs of increasing intermittent carotid insufficiency for more than six months prior to operation. Following surgery his symptoms were completely relieved, and the neurological examination three months later was normal. It is probable, however not proved, that also this operation was successful from an angiographic point of view.

In the group of six arteries with less satisfactory back-flow the results were poor. Angiography or autopsy revealed postoperative occlusion in four patients. One died of pneumonia nine days after operation, but autopsy was not made. The sixth patient had a hypoplastic but patent internal carotid artery. He died the day following operation, and autopsy revealed patency of the hypoplastic artery.

The technical results in the 15 arteries without back-flow were obviously unsuccessful.

Unfortunately a technically satisfactory operation with restoration of flow does not necessarily entail clinical improvement. From Table I it is apparent that only five of the eight controlled surgical successes were associated with clinical improvement, and only three of these five with complete recovery. On the other hand clinical improvement is no proof of a technical success as six of the 14 patients without back-flow improved postoperatively. Consequently an evaluation of the technical result is not possible without a postoperative angiogram or an autopsy.

The surgical risk is difficult to evaluate in a disease with an unknown spontaneous course. In the present series an operation is considered complicated whenever an immediate postoperative and lasting deterioration of the patient's condition occurred. Such a course was noted in four patients one of whom has been mentioned above in connection with the angiographical complications. Another patient, a man of 43, had bilateral internal carotid occlusion, and was operated upon on the left side 11 days after the apoplectic attack. No back-flow was obtained. He was awake before operation, but somnolent with increased hemiparesis afterwards. Death occurred seven days following operation, and an autopsy revealed infarction of the left cerebral hemisphere. A woman of 65 was operated on 12 hours following the attack. The left internal carotid artery was hypoplastic with a diameter of hardly three mm. Furthermore the artery was narrowed by an atheromatous plaque at the origin. Preoperatively she was soporose, postoperatively comatose until death the next day. Autopsy revealed infarction of the left hemisphere and very narrow vessels in the circle of Willis. A fourth patient, a 68-year-old man, was operated on 10 hours after the attack. He had a subtotal occlusion of the left internal carotid, and a spurting back-flow was obtained. Before operation he

was awake, afterwards soporous until death 36 hours postoperatively. Autopsy disclosed a patent left internal carotid artery, a haemorrhagic infarction of the left hemisphere, and a recent myocardial infarction due to coronary occlusion. This fatal outcome was probably provoked by a fall in blood pressure from 180 to 90 during operation and of approximately 15 minutes duration.

DISCUSSION

The apoplectic seizure in the present series of 300 patients was caused by extracranial occlusion or stenosis of the internal carotid artery in 20 per cent. Gurdjian & al. (1960) found a frequency of 25 per cent in 600 consecutive patients with cerebrovascular disease. The blocking lesion is, as in other arteries, most frequently an atheroma or a thrombus, or a combination of both.

Intermittence of symptoms is recognized as a characteristic sign of intermittent carotid insufficiency. In the present series of patients selected within the scope of the apoplœctic syndrome it occurs too infrequently to be of any practical importance to the exact diagnosis. In our experience palpation of the internal carotid through the lateral wall of the pharynx has been of no value, often even misleading. The retinal arterial pressure was measured in a majority of the patients, but the information obtained was of limited diagnostic value. Auscultation of the cervical portion of the carotid arteries is positive only in cases of subtotal occlusion, when a systolic bruit may be audible over the carotid bifurcation. Compression of one common artery may, in case of contralateral carotid insufficiency, result in syncope or convulsions. Gurdjian & al. recommend this manoeuvre as a diagnostic test; however, we have not used it in our patients.

The only reliable diagnostic measure is the carotid angiography, which should be carried out as soon as possible following the stroke. Complications are so rare that this examination is justified whenever a diagnosis is of interest. An angiogram should always include the carotid bifurcation which implies injection into the common carotid artery. Bilateral angiography is required to study such important features as the possible presence of bilateral occlusions, the function of the collateral systems and the patency of the middle cerebral artery on the side of the occlusion.

Several questions of importance to the surgical treatment and the prognosis are, however, not answered even by bilateral carotid angiography. The apoplectic seizure may be due to the demonstrated occlusion or to acute failure of the collaterals in patients with ancient and hitherto asymptomatic internal carotid occlusion. The angiogram gives no information on this point. The holding-up of the dye at the origin of the artery in the neck does not always tell with

certainly whether the blocking lesion is situated here or intracranially. Neither does it tell whether the cervical portion of the artery is patent, solid or hypoplastic. And exactly these unknown factors are decisive to the question of back-flow and thus for the technical result of surgery. Finally, it is not possible on the basis of angiographical or clinical information, to tell whether the cerebral disturbance is caused by reparable or irreparable damage to the affected cerebral zone.

The practical importance of these unknown factors is well reflected by the present surgical results: Twenty-six arteries with total extracranial arteriographical blocking were operated on. Complete clinical recovery associated with normal postoperative angiograms was obtained in only one patient (No. 24; Figs 1; 2; 3). Restoration of the internal carotid circulation, but no clinical improvement because of occlusion of the middle cerebral, was the result in another (No. 17; Figs 4; 5; 6). Operation on 8 arteries with subtotal extracranial occlusion resulted in only two complete clinical recoveries (patient No. 15 had no postoperative angiogram and No. 28 had normal postoperative angiography, Figs 7; 8), despite the demonstrated technical success of the operation in 5 of the 8 patients. This discrepancy between the technical and clinical results was due to impaired circulation of the middle cerebral artery (patient No. 6; Figs 9; 10; 11); impairment of both anterior and middle cerebral arterial circulation (patient No. 21; Figs 12; 13); infarction of the middle cerebral zone without occlusion; and to irreparable cerebral damage despite a normal postoperative angiogram (patient No. 30; Figs 14; 15; 16).

This result is, from a statistical point of view, not excellent. It could be improved by selecting for surgery only patients where a back-flow from the cranial end of the artery can be predicted, i. e. the group with subtotal occlusion. However, in the present series a satisfactory back-flow was obtained also in five of the patients with total blocking, one of these recovering completely with a normal postoperative angiogram. And, in this group, it is not possible, on the basis of the angiogram, to predict whether or not a back-flow can be obtained.

Postoperative non-filling of the middle cerebral artery will, most frequently, preclude or reduce the possibility of clinical improvement. Such patients possibly could be selected pre-operatively. In the pre-operative angiograms non-filling of the middle cerebral by the normal route, by the basal collaterals from the opposite internal carotid artery, and by the ipsilateral external carotid collaterals will probably indicate occlusion of the middle cerebral, or at any rate such impairment of circulation that cerebral infarction has occurred. The present material tells in favour of this assumption, but does not permit a definite conclusion.

Our surgical technique is identical with that described by Murphey & Miller (1959). Grafts were used in two instances with poor results because of postoperative thrombotic occlusion. While clamping the arteries in cases of subtotal occlusion with fair intracranial filling we have shunted the blood through a poly-ethylene tube from the common into the internal carotid artery above the obstruction. Other methods have been described and applied to small series of patients; but so far it is impossible to compare the results with those obtained by the present method. Lyons & Galbraith (1957) established a shunt from the subclavian artery to the internal carotid and claim to have re-established blood flow even in cases without back-flow from the cerebral end of the occluded internal carotid artery. Their postoperative evaluation is based upon clinical improvement and on pulsation in the neck, but they have no postoperative angiograms, and we have not been convinced by their results. The same omission of the only reliable postoperative control is found in several other series. In the literature Murphey & Miller were able to find 24 cases of claimed surgical restoration of carotid arterial blood flow. In only five of these the proof was given by postoperative angiograms. Six of their own 31 patients recovered completely clinically and had patent arteries in the postoperative angiogram. De Bakey & el. claim to have restored "a normal pulsatile blood flow" in 92 of 105 internal and common carotid arteries operated upon. Postoperative angiograms are reproduced from two of these patients, but are otherwise not mentioned.

The value of pre- and postoperative anticoagulant treatment is difficult to estimate and our small figures do not permit a conclusion on this point. We have given anticoagulants to 14 of the patients. In six it was started before the operation and it was continued in patients where a back-flow was obtained.

Thus, a number of important questions are still open to discussion. In our opinion these questions can be answered only on the basis of large series

of patients thoroughly studied by bilateral arteriography as soon as possible following the cerebrovascular attack; by explorative surgery and by postoperative clinical and angiographical control. Prevention of postoperative thrombosis is a special problem which needs further study. However, restoration of the carotid arterial circulation is possible, and this restoration may be associated with clinical recovery. Despite poor statistics each such result represents an individual relieved from manifest or imminent incapacity, and a future with two functioning carotid arteries instead of one.

SUMMARY

Three hundred consecutive instances of cerebral apoplexy were studied angiographically. The cerebrovascular attack was, in 20 per cent, caused by extracranial carotid occlusion. Thirty-four arteries in 32 patients were operated on with removal of the blocking lesion. A satisfactory back-flow from the cranial end of the internal carotid was obtained in five of 24 arteries with complete arteriographical blocking, and in all eight patients with incomplete blocking. Restoration of the internal carotid arterial circulation was demonstrated postoperatively in seven patients, but only three patients made a complete recovery.

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EXPERIENCE WITH ALCOHOL BLOCK OF THE LUMBAR SYMPATHETIC TRUNK

By HARRY RASK

In patients suffering from circulatory disturbances in the lower limbs, a greater or lesser degree of vascular spasm is frequently present independent of the etiology of the condition. This spasm and accompanying vascular pain may be abolished or relieved by interruption of sympathetic function either on account of the vasodilatation thereby produced or by interruption of the afferent vascular nerve fibres (1, 32).

By experimental investigations of the effect of sympathectomy in animals Theis (31) demonstrated by calorimetric, plethysmographic and oscillometric measurements that sympathectomy produces arterial dilatation, increase in temperature both of the skin and the underlying tissues, increased blood pressure (approximately 15 per cent) and increased blood volume (approximately 60 per cent).

Transient inhibition of the sympathetic action in the lower limbs may be produced by spinal anaesthesia, peridural anaesthesia, paravertebral block in the lumbar region and regional block of the sciatic nerve (1, 32). Such blocks are undertaken with short-acting local anaesthetics such as xylocaine and carbocaine. More prolonged inhibition may be obtained by employing continual spinal anaesthesia as introduced by Lemon (10, 26).

Prolonged and "irreversible" alteration of the action of the lumbar sympathetic trunk may be obtained either by surgical sympathectomy, which appears to have been undertaken for the first time by Julio Diez (3) in 1924 (in a patient suffering from thromboangiitis obliterans), or by the injection of injurious substances such as alcohol around the sympathetic trunk. This method was introduced in 1930 by Stern (28).

These two forms of treatment have thus been employed clinically for 30 years but surgical sympathectomy has been the dominating method. The immediate reason for this is that an intervention undertaken under direct visual control ensures a better result than a blind method such as injection treatment.

The results of surgical sympathectomy are, however, far from satisfactory. Yeager & Cowley (35) report good results in 31 per cent out of 150 patients. Nelson & Trimble (18) report poor results in 59—74 per cent out of 192 patients representing 272 limbs. Berry, Flotte & Collier (2) undertook 391 lumbar sympathectomies in 275 patients. Good results

were obtained in 34 per cent. In more extensive materials in recent years, good results appear to be obtained in 30—40 per cent of the interventions. Very little information is available regarding the duration of the result but the patient material is not homogeneous, the age of the patients advanced and the indications for the intervention and the control of its effects varying and difficult to classify. Holopainen (7) undertook follow-up investigations $\frac{1}{2}$ —2 years, 2—5 years and 5—10 years after operation and found approximately the same percentage distribution of improved and unimproved cases in the various groups.

In evaluating surgical sympathectomy, the operative mortality which varies from 0.7 to 5.5 per cent in direct connection with the operation (27) must also be considered.

Blockage of the lumbar sympathetic trunk with alcohol was undertaken, as mentioned already, by Stern (28) in the treatment of thromboangiitis obliterans in 1930. In 1931, Flothow (4) demonstrated the effect of lumbar alcohol block in cases of peripheral arteriosclerosis and reported that he had obtained good results in seven out of eight patients. In 1933, Reichert (14) reported that 25 patients with intermittent claudication had obtained striking benefit from alcohol block. In 1934, Gage (5) proposed alcohol block prior to operations for aneurysm to increase the circulation of blood in the lower limbs and to prevent postoperative vascular spasm and gangrene and in 1940, the same author (5) reported that in 15 cases of operation for aneurysm preceded by alcohol block no complications in the form of gangrene occurred. Saland & Klein (24) report that out of ten patients submitted to alcohol block for intermittent claudication, improvement occurred in five, three remained unchanged and two deteriorated. Mandl (14) found (1947) improvement in ten out of 14 patients with intermittent claudication.

Alcohol block is recommended in Buerger's disease by Ruth (23), White (32), Mandl (14), Patterson & Stainski (20) and in arteriosclerosis obliterans by the McKittrick (16) and Saland & Klein (24).

Both where these works are concerned and with those mentioned under surgical sympathectomy, no mention is made of the duration of the effect of treatment.

The less favourable results both of surgical and injection treatment are due, as emphasized by all who have been concerned with these in-

terventions (1, 27, 29, 32), not only to the absence of well-defined criteria for the actual intervention but also to the absence of a simple classification of the various diseases in the vessels of the lower limbs and graduation of the stages of disease in these; also lacking are good methods of investigation and of control of the effects achieved and to a very great extent, familiarity with the anatomical relations of the sympathetic trunk itself.

ANATOMY

The sympathetic innervation of the lower limbs comes from the 11th. and 12th. thoracic segments and from the 1st and 2nd lumbar segments (exceptionally from 10th thoracic or 3rd lumbar segments) and the preganglionic fibres pass thence out along the anterior root of the corresponding spinal nerves and thence as 4-6 white rami communicantes to form, in the lumbar sympathetic trunk, the lumbar ganglia with the post-ganglionic nerves.

The lumbar part of the sympathetic trunk is situated on the antero-lateral surface of the bodies of the first to fifth lumbar vertebrae. The number of ganglia varies from two to five on each side; three being most frequent. As a rule, a ganglion is situated somewhere or other on the second lumbar vertebra and frequently no ganglia are related to the first lumbar vertebra. The ganglia are frequently fusiform and vary in size from the head of a pin to 6 mm wide and up to 60 mm long.

The sympathetic trunk is seldom identical on the two sides. The communicatory fibres between the individual ganglia and with the spinal nerves show just as much variety as the number and size of the ganglia. White fibres pass from the 1st and 2nd and occasionally from the 3rd and very rarely from the 4th lumbar spinal nerves to the corresponding ganglia.

In nearly all cases, there appears to be a communicating fibre from one sympathetic trunk to the other. Ganglia situated actually in the psoas musculature have also been described (34).

The post-ganglionic fibres either pass to the iliac vessels and thence down into the lower limbs or as grey rami communicantes to the spinal nerves which form the lumbosacral plexus and with them to the lower limbs.

All of the sympathetic fibres below the middle of the femur run alongside the peripheral nerves and above the middle of the femur electively along the vessels. (This is the reason why periarterial "stripping" frequently does not render satisfactory results).

ALCOHOL

The effect of absolute alcohol on the sympathetic nerves and ganglia has been described by Merrick (17), who found that the effect of infiltration with alcohol on nerve fibres was transient while infiltration of a ganglion with

alcohol produces permanent interruption of the sympathetic innervation via the post-ganglionic fibres from the ganglion concerned because the cells in the ganglion are destroyed by the alcohol.

Treatment of the preganglionic fibres with alcohol does not influence their cells of origin which are in the medulla but the myelin sheath is destroyed and the axons undergo Wallerian degeneration. The fibrosis produced by alcohol may inhibit regeneration (25).

Block of the postganglionic fibres may also be undertaken without affecting the nerve cells in the ganglia as, according to Merrick, the ganglia are considerably more resistant to the influence of alcohol than the nerve fibres.

In block of the rami communicantes, regeneration should be demonstrable at the latest by the 90th day and should be complete before the 170th day.

The observation that occasionally more pronounced effect of alcohol block is observed after the elapse of a few days is said to be due to the fact that a progressive anaesthetizing of the individual nerve fibres occurs depending upon their tickness, and that degeneration of the individual fibres perhaps takes place gradually (19).

The spread of alcohol in the tissues was investigated by White (32), who demonstrated that five ml alcohol injected into the muscles of the thigh in a rabbit caused a necrotic zone of slightly more than one cm in diameter.

No report of the extent of paravertebral spread is available, but injection of Indian ink mixed with alcohol, at operation a few days later the author has observed spreading along the sympathetic trunk to an extent of 10-12 cm, and by injection of methylene blue into cadavers, spread to an even greater extent was observed following injection of five ml fluid.

ALCOHOL NEURITIS

This complication is regarded as being so unpleasant that many surgeons (*e. g.*, Leriche (11)) abstain from the use of alcohol solely for this reason. This form of neuritis is considered to be due to incomplete destruction of somatic nerves and it occurs 7-10 days after blockage, *viz.*, at a time when most of the patients have left hospital.

The neuritis or neuralgia occurs, as a rule, on the outside of the thigh corresponding to the lateral cutaneous branch of the femoral nerve but it may also radiate to the anterior surface of the thigh as if due to involvement of the femoral nerve. In a number of cases, it occurs as lumbosacral neuritis with pain in the groin. On the other hand, pain in the genitalia never occurs so the condition cannot simply be explained by damage to the genito-femoral nerve, even although this nerve is very exposed in the substance of the psoas muscle just at the site of election for

block alongside the second lumbar vertebra. Similar pain may occur following surgical sympathectomy about the tenth day and may persist for 4-6 weeks (30). Most probably, commencing regeneration is concerned and the condition thus due to an irritative lesion.

De Takats (30) states that the incidence of post-sympathectomic neuralgia has increased steadily from 10 per cent in the nineteen thirties to nearly 100 per cent nowadays when perhaps more attention is paid to the phenomenon. Holopainen (7) reports the incidence of neuritis to be 21 per cent after surgical sympathectomy. In alcohol block, White (32) reports the incidence of severe neuritis to be 10 per cent in extensive materials (actual numbers not stated). Mandl (14) reports an incidence of two per cent out of 100 patients. As a rule, the incidence of neuritis appears to be about 10 per cent.

In addition to neuritis, other complications of interruption of sympathetic innervation in the lumbar region will be mentioned, such as impotence following bilateral intervention and de Takats' phenomenon.

Impotence.

Following removal or destruction of the first lumbar ganglion on both sides, the ability to ejaculate is lost, according to Learmonth (9). This statement is contested by White (32). Many of the patients are of an age at which an intervention upon the sympathetic system causing only slight functional disturbance may be result in considerable psychic effect.

Whitelaw & Smithwick (33) found transient or permanent loss of erection in 63 per cent following bilateral sympathectomy and permanent impotence in 54 per cent out of 183 patients.

De Takats' Phenomenon.

By this is understood the phenomenon that, following block of the sympathetic trunk, a paradoxical fall in the skin temperature on the treated side is observed and frequently associated with aggravation of the pain (29). A condition is concerned of complete failure of the ability of the terminal vascular branches to dilate, with bypassing of the limited blood volume present to regions of lesser peripheral resistance. All of these patients have pronounced obstruction in the main artery and scanty collateral vessels. If sympathectomy or alcohol block is undertaken, the surgeon is most frequently forced to amputate on account of gangrene in the course of a very short time.

METHODS

Before the material is described, brief accounts will be given of the various methods of investigation employed to evaluate the condition of the patients and to control the results obtained, to-

gether with the technique employed in alcohol block of the lumbar sympathetic trunk.

Measurement of the Skin Temperature. Many factors are involved in measurement of the skin temperature: Region, temperature of surroundings, diurnal variations, emotional state, tobacco smoking, intake of food and pyrexia. No given relationship exists, for example, between the temperature of the toes and the temperature of the calves nor between the circulation of blood through the skin and through muscle tissue (1).

If measurements of temperature are to be comparable, they must be read under standard conditions, *viz.*, under uniform conditions, *e. g.* in a room with constant temperature, stationary air, constant humidity and at the same time of the day.

The patient must also be under "basic conditions", *viz.*, mentally calm, he must not have consumed food for the past 4-6 hours, must not have smoked for two hours and the skin temperature must have had time to become stabilized for 1-2 hours.

Only a few investigators have access to such conditions (climatic room). In this hospital, the routine practice is to measure the temperature half an hour after uncovering and again 30 minutes after block with short-acting local analgesics. Considerable cooling always occurs during this time partly from doors and windows which are frequently opened and closed. The temperature in the room varies from 20-23° C.

The fact that measurements of temperature are, nevertheless, employed is because exists as a rule a difference of 4-5° C. before and after blockage provided the patient has a spastic element in the peripheral vascular disease. In addition, the non-blocked side serves as a control.

Control investigations prove more difficult. Here the difference between the two sides may be utilized provided that both limbs have not been blocked, but this is frequently the case. A certain value must, nevertheless, be attributed to measurement of the skin temperature, as a fall in the temperature is invariably recorded when the patient complains that a sensation of cold is again experienced.

Sympathogalvanic Reflex (SGR). The sympathogalvanic reflex as it was termed by Lewis (13), is a reflex which is conducted from the skin. The efferent nerve fibres for this reflex are solely sympathetic nerves. Every sensory stimulus (noise, pinpricks, sudden light in the eyes, Valsalva's experiment etc.) will produce the reflex provided the sympathetic nerve channels are intact. The electric activity recorded is said to be due to activated action-potentials in the sweat glands. This theory is supported by the fact that the reflex cannot be produced when atropine has been administered (personal observation).

The SGR is measured by an electrocardiograph one electrode of which is placed in the dorsum

of the foot and the other on the sole. Employing a two-valve electrocardiograph with a paper recorder, readings may be taken from both lower limbs simultaneously. The recorder is set slowly in motion and the reflex is initiated by, for example, clapping the hands.

If the patient is at rest and the sympathetic innervation intact, a sine-shaped curve is recorded. If the sympathetic function is interrupted by lumbar block with local analgesia, no reaction is observed on the blocked side while the recording from the other extremity in sine-shaped as previously.

This investigation is useful but there are sources of error. According to Lewis, the reflex is put out of action by ganglion-blocking drugs, barbiturates and anesthesia, shortly before death and in certain diabetic patients. Investigation of the patients in this material demonstrated that the reflex is also abolished under the influence of morphia. In ten young adults to whom 50 mg chlorpromazine was administered intramuscularly, the SGR was found to be abolished in five at control investigation an hour later. In the remaining five, the reflex was as active as on examination prior to the administration of chlorpromazine. The reflex is always abolished following the administration of atropine. In isolated diabetic patients, it proved impossible to produce the SGR reflex. In isolated patients, it did not prove possible to abolish the reflex although measurement of the skin temperature showed an increase of 6–10° C. indicating that the test block was effective. This phenomenon may probably be due to untouched sympathetic fibres running in the psoas musculature.

The advantages of the method are its independence of the external temperature, equilibration becomes unnecessary, no extra apparatus is required as an ordinary electrocardiograph with an automatic recorder may be employed and the method is easy to carry out and does not cause any discomfort to the patient.

Oscillometric investigations were not undertaken as they only record the pulsation in the larger arteries and give no information whatsoever about the collaterals (1).

Walking tests could not be employed as a routine as, on account of previous amputations, gangrene etc., the condition of many of the patients was too poor to permit these.

Although the number of steps which could be taken before cramp in the calves developed was quite constant for each individual patient, the tempo is of considerable significance. Many patients who develop cramp in the calves following walking normally for 100–200 m are able to walk for a half to two hours provided they walk slowly.

On account of the absence of suitable apparatus, plethysmography was not carried out.

TECHNIQUE OF ALCOHOLIC BLOCK

The patient is placed in the lateral position over a wooden box from which the X-ray cassette can easily be removed. The lower leg is maintained in the extended position and the upper leg is flexed to 90° at the knee and 45° at the hip. The shoulders are drawn forwards and the chin pressed down towards the chest. The position is maintained by means of adhesive plaster over the hips and the thorax. An Olavsson's cannula is introduced into a vein. According to the age of the patient, 12.5–100 mg pethidine are administered. Oxygen and Pentothal should be available.

Three long needles are introduced corresponding to a perpendicular line drawn from a point 10–12 cm out along the twelfth rib. The needles are introduced at an angle of 45° to the tangential lateral plane and an attempt is made to let the tip of the needle just glide over the antero-lateral angle of the body of the lumbar vertebra with the tip constantly against the bone. Aspiration is undertaken and provided no blood is obtained, one ml 2 per cent carbocaine without adrenaline is injected and a metal stopper inserted into each cannula. A control X-ray photograph is then taken and a picture showing the position in the lateral plane obtained. If the tip is anterior to the edge of the bone, the position is satisfactory. After ensuring that the needle is still in contact with bone, one ml absolute alcohol is slowly injected into each needle. The metal stoppers are re-introduced after each injection. One minute later, another one ml alcohol is injected and the needles are removed.

In the patients in whom the block is performed under general anaesthesia, the intervention is undertaken in bed. Following anaesthesia with Pentothal, pethidine and N₂O with intubation, the patient is placed in the lateral position and the X-ray cassette in its wooden box is placed under the patient and the needles introduced. Isolated patients are anaesthetized at one session. In the anaesthetized patients, carbocaine is not injected. This procedure is frequently employed as an indication that the needles are correctly situated (warmth in the lower limb on the blocked side).

Patients receiving anticoagulation therapy or with a prothrombin value of less than 60 are not submitted to alcohol block.

MATERIAL

The material comprises 310 patients. The age and sex distribution are apparent from Table 1. There is a slight preponderance of males, particularly in the age group 50–59 years. As might be anticipated, the majority of the patients are between 60 and 80 years, after which age the number of patients falls rapidly corresponding to the relatively few individuals who attain such advanced ages in the population.

Table 1.
Age and Sex Distribution.

	Under 50	50-59	60-69	70-79	Over 80	Total
Females	14	24	35	41	14	128
Males	14	50	54	51	13	182
						310

At the commencement, alcohol block was undertaken under general anaesthesia and the intervention was only undertaken under local analgesia in a very few patients. Later, all of the alcohol blocks were undertaken under local analgesia.

The 310 patients were submitted to a total of 483 blocks and of these 121 were performed under general anaesthesia and 362 under local analgesia.

Table 2.
Complications.

	Total	Local analgesia	General anaesthesia
No. of blocks	483	362	121
Anaesthetic complications	4	2	2
Neuritis slight	30 (6%)	24	6
severe	5 (1%)	4	1
Impotence	4	3	1
Herpes zoster	2	2	0
No. of patients	310	310	310
	Death in connection with block	Death later	
	1	53	

In Table 2 the complications of alcohol block are recorded and the number of patients who died until the time of analysis of the material.

COMPLICATIONS OF ANAESTHESIA

A male aged 69 years suffering from intermittent claudication died 1½ hours after the intervention without recovering consciousness following general anaesthesia. At autopsy, a fresh coronary occlusion with commencing leucocyte infiltration was found. Review of the case history revealed that the patient has experienced transient pain in the chest on the day prior to the intervention.

Another complication in connection with the intervention under general anaesthesia occurred in a male aged 56 years, also suffering from intermittent claudication. At the commencement of the anaesthesia, a fall in the blood pressure to 65 mm Hg (systolic) occurred. (Anaesthesia: N₂O/O₂, 6/2 litres + pentothal, pethidine and d-tubocurarine). At the conclusion of the anaesthesia, the patient was confused and restless and flaccid paresis of the left arm and left leg was present. The diagnosis of cerebral thrombosis was

made. On discharge, the patient had no cerebral symptoms and good power in the left arm but flaccid paresis of the left lower limb persisted. Arrangements were made for an invalid pension.

Complications occurring in connection with alcohol block performed under local analgesia consisted of pain in the loins and pyrexia of about 38° C (100.4° F) in a male aged 69 suffering from pregangrenous changes. Some days later a retroperitoneal haematoma was discovered (anti-coagulation therapy had not been employed). The course was uncomplicated.

A complication which perhaps cannot be directly connected with the alcohol block therapy occurred in a female aged 78 years with arteriosclerosis in both lower limbs. Block was performed in the forenoon and in the evening the patient developed a pulmonary embolism. The patient recovered after some days and no further complications occurred.

Neuritis. In 35 cases, the alcohol block caused neuritis. Thirty of these cases did not require treatment or were relieved by drugs of the acetyl salicylic acid type. The symptoms experienced were hyperaesthesia in the lumbo-inguinal region or along the outer aspect of the thigh. Five of the cases were more severe and did not disappear until after treatment with lumbar sympathetic block with carbocaine, one block daily for 4–6 days. In addition, chlorpromazine and nembutal were administered. The symptoms of neuritis appeared from the 6th–7th days and persisted from eight days to several months.

In one out of the five severe cases of neuritis, a male aged 59 years suffering from Buerger's disease, there was also loss of power in the lower limbs. Alcohol block had been undertaken under general anaesthesia and so no information regarding pain at the actual intervention was available (injury to the roots), but neurological investigation revealed motor involvement of L_{III} and motor and sensory involvement of L_{IV-V} and S_I.

The patient responded well to physiotherapy but did not recover completely until after six months.

Impotence. Patients were not questioned routinely about this complication even although bilateral block had been undertaken. Four of the patients, however, volunteered that they had become impotent following the intervention. None of the patients who had been subjected to unilateral block complained of impotence.

Herpes Zoster. This developed in one patient 14 days after the intervention and in another one month after block. In both of these patients, introduction of the cannula had been associated with pain.

Deaths. In addition to the patient who died in connection with the intervention, 53 out of the 310 patients died during the period of observation. A female aged 79 years suffering from femoral thrombosis, died one day after the inter-

vention. Autopsy showed thrombosis of the femoral artery and vein and arteriosclerotic heart disease. A male aged 58 years suffering from phlebitis died on the day after block from pulmonary embolism. A female aged 63 years with phlebitis died four days after block from pulmonary embolism. A female aged 50 years with acute vascular occlusion in both lower limbs died four days after bilateral block under local analgesia. Autopsy revealed thrombosis of the aorta. A female aged 69 years with emboli in the right arm and the left leg died four days after block under local analgesia and autopsy revealed coronary occlusion. A female aged 70 years died four days after block and on the day after an amputation through the thigh. Autopsy revealed myocardial degeneration. A female aged 73 years died ten days after block under local analgesia from cerebral softening. The remaining patients died more than 14 days after establishment of the block.

A list of the symptoms (diseases) comprising the indications for block, number of extremities treated and the results of the treatment, duration in months of relief of symptoms and cases of amputation are tabulated in Table 3. The seven groups will be dealt with separately in the following:

1. Buerger's disease: The material comprises 18 patients, 14 males and four females. The duration of the condition was from one to 16 years. A total of 29 extremities were treated with one or more blocks. Sensation of warmth, reduction of pain and ability to walk longer were obtained in 15 cases. No effect was obtained in 13 extremi-

ties but among these are included seven extremities in which effect on the pain was obtained from 3—4 days to nearly three weeks (block in which the ganglia were not involved). In one case, aggravation of the condition was observed. The average duration of the block before sensation of cold and pain returned was eight months. Five patients were submitted to amputations: two thigh amputations, two leg amputations and a single toe was removed in one patient who became symptomfree after alcohol block and in whom gangrene was limited to the pulp of a toe.

Symptoms returned after eight months in patients with claudication and after seven months in patients with claudication and pain at rest.

2. Arteriosclerosis of the lower limb: This group comprised 52 patients in whom a total of 82 limbs were treated. The symptoms complained of were: sensation of coldness, intermittent claudication and, where extremities were concerned, also pain at rest. None of these patients had trophic changes. Out of 65 cases with claudication, improvement lasting for more than a month occurred in 35 cases. Out of 17 cases where pain at rest was also present, five improved. Out of the 65 cases with claudication, 23 remained unchanged, two deteriorated and the effect in five cases was not known. In limbs with pain at rest, 11 out of the 17 remained unchanged, none deteriorated and the result was unknown in one case. Two patients were submitted to amputation through the thigh on account of pain. In five patients, plastic operation was undertaken for obstruction in the femoral artery.

Table 3.

Entire Material: Indication for Block, Return of Symptoms and Amputations.

	Patients	Limbs treated	Limbs improved	Average duration months	Unchanged	Deteriorated	Unknown	Thigh amputation	Leg amputation	Forefoot amputation	One or more toes	Total amputations	Blocks under local analgesia	Blocks under general anaesthesia	Total no. of blocks
1. Buerger's Disease.	18	29	15	8	13	1	0	2	2	0	1	5	19	16	35
2. Arteriosclerosis without trophic changes	52	82	40	7—8	34	2	6	2				2	75	27	102
3. Arteriosclerosis with trophic changes	74	101	36	7	48	4	13	25	5	3	6	39	98	22	120
4. Diabetic arteriosclerosis	69	96	31	7—8	47	6	12	13	13	3	5	34	77	26	103
5. Acute vascular obstruction	38	42	13	"6"	23	3	3	10	1	0	0	11	39	6	45
6. Phlebitis	22	23	19	"7"	2	0	2	0	0	0	0	0	22	3	25
7. Heterogenous group	37	43	28	"6"	14	0	1	0	0	0	0	0	32	21	53
	310	416	182		181	16	37	52	21	6	12	91	362	121	483

Table 4.

	Pregangrenous changes	Ulceration	Gangrene	Total
Patients	47	17	10	74
Extremities treated ..	72	18	11	101
1) Improved for more than one month ..	31	5	0	36
Average duration of block (months) ...	6—7	8		
2) Unchanged extremities	31	7	10	48
(Of these with effect for less than one month)	(9)	(2)	(4)	(15)
Thigh amputations	10	5	6	21
Leg amputations ..	4	1	0	5
Forefoot amputations	0	1	2	3
Amputation of single toes	4	1	1	6
3) Deteriorated	2	1	1	4
Thigh amputations	2	1	1	4
Leg amputations ..	0	0	0	0
Forefoot amputations	0	0	0	0
Amputation of single toes	0	0	0	0
4) Fate unknown	9	4		

3. Arteriosclerosis of the lower limb with trophic changes: This group comprises 74 patients. The trophic changes are subdivided into pregangrenous changes, ulceration and manifest gangrene. The distribution is apparent from Table 4. Out of 72 treated extremities in the pregangrenous group, improvement was obtained in 31 (43 per cent). Among the extremities with ulceration, five out of 18 improved (28 per cent). In the extremities with gangrene, the results were poor; in no case did gangrene regress, but in four out of ten limbs, the pain was reduced for some days up to a fortnight. In the four patients in the pregangrenous group, in whom amputation of a single toe was undertaken, three are recorded among those who improved as warmth and diminished pain were recorded and the pregangrenous changes regressed while the fourth patient was classified with those who improved for less than a month. In two cases in whom the pain became more pronounced after alcohol block, amputation through the thigh was performed. In the group with ulceration, healing and improvement were obtained in five out of 18 extremities. Out of seven unchanged cases, the ulceration in one case proved to be carcinomatous. One case deteriorated and amputation through the thigh was necessary. A total of six amputations through the thigh and one through the leg were undertaken while, in one patient, a forefoot amputation sufficed and in another removal of a single toe.

As might be anticipated, no regression occurred among the cases with manifest gangrene. A total of 11 extremities were treated and in four amelioration of pain lasted for less than a month. In one case, the pain became worse. Amputation was performed in ten cases, in two cases only forefoot amputation was necessary and in one case removal of a single toe. In one patient, the general condition was so poor that operation was not undertaken.

Arteriosclerosis of the lower limb in patients with diabetes mellitus: These patients are classified as an independent group. Extensive literature exists on the question whether diabetic patients develop ordinary arteriosclerosis in the vessels of the lower limbs or whether a diabetic non-arteriosclerotic angiopathy is the etiological agent responsible for the vascular lesion (15, 21). As it has not proved possible clinically to differentiate between ordinary arteriosclerosis and diabetic angiopathy in its various degrees, all of the diabetic patients with arteriosclerosis are classified in one group in this material. In all 69 patients representing 96 extremities were concerned. In 35 cases treatment was undertaken on account of subjective sensation of cold, claudication and pain at rest and in 61 cases the patients had trophic changes. To investigate whether the duration of the diabetes mellitus influenced the result of treatment, the material was subdivided into four groups: Diabetes diagnosed at the time of treatment, of less than five years' duration, between five and ten years' duration and with a duration of more than ten years (Table 5). Out of nine extremities in patients with newly diagnosed diabetes, improvement was obtained in three (33 per cent). In two of these, however, amputation of a single toe was performed. In one patient with gangrene, amputation through the thigh was undertaken. In patients in whom the diabetes had been present for less than five years, 20 extremities were treated. In eight (40 per cent) improvement was obtained while in nine cases there was no change and one limb became worse. Amputation through the thigh was undertaken in two of the patients without trophic changes on account of ischaemic pain. Amputation through the leg was performed in two patients on account of gangrene, while in one of the patients in whom the condition was unchanged, a single toe had to be removed. In patients in whom the diabetes had been present for five to ten years, improvement was obtained in 11 (34 per cent) out of 28 extremities. In this group, there was a preponderance of the number of extremities with trophic disturbances and in seven out of 22 extremities amputation was necessary. Out of 16 extremities without trophic changes, amputation was undertaken on account of pain in two limbs. In patients with a history of diabetes for more than ten years, improvement was obtained in nine out of 39 extremities (23

Table 5.
Diabetic Arteriosclerosis.

	Newly diagnosed		< 5 years		5-10 years		> 10 years		
No. patients	6		14		19		30		69
Extremities treated	9		20		28		39		96
	Cold, claudication & pain at rest	Trophic changes	Cold, claudication & pain at rest	Trophic changes	Cold, claudication & pain at rest	Trophic changes	Cold, claudication & pain at rest	Trophic changes	
	6	3	12	8	6	22	11	28	
Improved	1	2	5	3	3	8	3	6	31
Duration of effect	"12"	"10"	"10"	"5"	"5"	"8"	"6"	"5"	
Effect < 1 month	2					1			3
Unchanged	2	1	5	4	1	5	6	20	44
Worse	1		1		1	1	1	1	6
Unknown	0	0	1	1	1	7	1	1	12
Thigh amputation		1	2		1	3		6	13
Leg amputation.				2		2		8	13
Forefoot amputation						2		1	3
Toe amputation		2		1		0		2	5

per cent). In 26 patients of whom 20 had trophic changes, the alcohol block did not produce any effect. Deterioration occurred in only one case. Seventeen operative interventions were performed.

5. Patients with acute vascular occlusion which had been present from a few hours to a few days. Forty-two limbs were treated in 38 patients, as in four of the patients bilateral block was performed. In 32 limbs, signs of occlusion in the proximal part of the femoral artery were found and in ten distally in the femoral artery or in the popliteal artery. The four patients in whom bilateral block was performed will be briefly reported:

A female aged 57 years developed embolism with abolished pulsation in both femoral arteries a few days after pneumonectomy with pericardial resection. Bilateral block was undertaken under local analgesia. Thereafter warmth appeared in both lower limbs but the toes were cyanosed. Two days later, the right lower limb was in satisfactory condition while the left was ischaemic distal to the middle of the calf. Moist gangrene developed and amputation was undertaken through the left thigh. A female aged 73 years developed embolism of the aorta three days after a gastric operation. Embolectomy was performed, but as both lower limbs were cold and cyanotic

on the day after operation, bilateral alcohol block was undertaken. Good effect was obtained on the right side while, on the left side, the great toe was cyanotic and the remainder of the limb was warm. The left big toe was amputated. Thereafter, the patient was free from pain in both lower limbs. On the left side, a slight tendency to oedema was present and the foot was slightly cyanotic. A female aged 57 had suffered from claudication for three years. Following acute deterioration on the left side, bilateral block was undertaken. The block did not produce any effect upon the pain and temperature. The SGR was abolished on the left side but not on the right. Arteriography on the left side revealed occlusion of the left popliteal artery and the deep femoral artery. A female aged 50 years was admitted with cyanosis and abolished pulsation in the left lower limb of acute origin. Two days later, the pulsation in the right lower limb was also abolished. Bilateral alcohol block was undertaken with resulting increase in the skin temperature and abolishment of the SGR but the patient's condition deteriorated and she died four days later. Autopsy revealed thrombosis of the aorta.

In the limbs which were treated for obstruction high in the femoral artery, good effect was obtained in nine. Embolectomy was performed in one of these patients. The average duration of

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Table 6.

	Obstruction high in femoral artery	Obstruction distal in femoral artery	Total
No. patients	28	10	38
Extremities	32	10	42
Improved	9	4	13
Improved in months	"6"	"6"	
Effect < 1 month ..	1	0	1
Unchanged	18	4	22
Deteriorated	2	1	3
Unknown	2	1	
Thigh amputation..	7	3	10
Leg amputation	1	0	1

the block was six months. Eighteen extremities were unchanged and in one effect for less than a month was observed. Embolectomy was performed in two patients. Two limbs became worse and two cannot be accounted for. Seven amputations through the thigh and one through the leg were undertaken. Ten extremities with more distal occlusion were treated in ten patients and good effects was observed in four, four remained unchanged although in one of these effect lasting for some days was observed. One extremity deteriorated and one cannot be accounted for. Amputation through the thigh was undertaken in three extremities on account of gangrene.

6. The group with phlebitis comprised 22 patients in whom 23 extremities were treated as one patient was treated for phlebitis first on one leg and, later, for the same condition in the other leg. In 19 extremities, improvement was obtained, *i.e.*, amelioration of the pain occurred. In the four remaining extremities, no effect was observed in two while one patient died on the day after the alcohol block (a male aged 58 years who developed phlebitis on the left side ten days after cholecystectomy and died from pulmonary embolism) and one developed phlebitis in the right lower limb during the first day in the ward (a female aged 63 with cancer of the caecum, not submitted to operation). The general condition was poor and the patient died four days after the alcohol block. Autopsy revealed pulmonary embolism. In 14 extremities, the subsequent course was uneventful while in seven, permanent changes persisted in the form of pain and oedema. No recurrence of symptoms occurred in these patients and the duration of the block was approximately seven months.

7. A heterogeneous group which is specified in more detail in Table 7 consisting of:

a. Fifteen patients with reflex dystrophy. The diagnoses were established by a neurologist. In 11 good effect with improvement of the circulation and reduction of pain was obtained. In one

extremity, effect was obtained for a few days and in three no effect was observed.

b. Arterial insufficiency. Nine patients were treated representing 12 extremities. The patients in this group include conditions such as congenital dislocation of the hip, previous poliomyelitis, previous thrombosis, vascular pain of unknown etiology and previous frostbite. In nine out of the 12 extremities treated, good effect lasting for about six months was obtained. One patient had effect for less than a month and in two no demonstrable effect was observed. No amputations were performed in this group.

c. Delayed healing. A female aged 52 years with a fracture of the leg. Fourteen months later, there was still movement at the site of the fracture. Alcohol block and drilling of the fracture by Beck's method were performed. The effect could not be recorded as the limb was in plaster. Shortly afterwards, osteosynthesis was performed. A female aged 42 years with a complicated fracture of the leg. No callus had developed seven months later. Alcohol block was performed with good effect on the pain and the temperature. Five months later, sensation of cold and SGR were present. A male aged 68 years with a fracture of the leg. Nine months later, pronounced halisteresis and movement at the site of the fracture were present. There was no measureable effect following alcohol block.

d. Sequelae of laminectomy. This group comprises nine patients in whom 12 extremities were treated with alcohol block on account of pain in the lower limb and in whom test block had given relief from pain for some hours. Good effect lasting for an average of seven months was obtained in six extremities, two were free from pain for less than a month and in four there was no effect.

e. An isolated patient with pain in the back of unknown origin with radiation to the right leg. No disk prolapse could be demonstrated. Alcohol block was performed and the patient was free from pain and the extremity was warm for four

Table 7.

	No. Patients	Extremities	Improved (months)	Unchanged Of these improved < 1 month	Deteriorated	Unchanged effect	Amputations
Reflex dystrophy....	15	15	11 (6)	4	1	0	0
Arterial insufficiency	9	12	9 (6)	3	1	0	0
Delayed healing	3	3	1 (5)	6			1
Sequelae of lami- nectomy	9	12	6 (7)	6	2	0	0
Pain in back (unknown origin) ..	1	1	1 (4)	0	0	0	0

months when the sensation of cold and the SGR returned and pain was experienced again.

This latter intervention and the blocks undertaken for the sequelae of laminectomy were undertaken on indications established by the neurological department in patients in whom good response to test block had been obtained.

Diabetes Mellitus and SGR.

In 27 patients with diabetes who had not been sympathectomized previously and who were not receiving drugs, the SGR was found to be absent in four prior to test block. Investigation of the duration of the diabetes in these patients showed that there was one in each of the groups of duration: newly diagnosed, less than five years, between five and ten years and more than ten years. It is thus impossible in this material to establish any relationship between the duration of the diabetes and the time of origin of such pronounced neurovegetative changes that active sympathetic innervation was no longer present.

Comparison between the SGR and the skin temperature after test block was undertaken in 142 extremities (Table 8). Abolishment of the SGR and raised skin temperature was found in 111 extremities and these blocks must be considered to be effective in patients with normal sympathetic function and responsive vessels.

Table 8.
Results of Test Block in 142 Extremities.

SGR abolished and higher skin temperature	111
SGR abolished and unchanged skin temperature	15 (7)
SGR present and higher skin temperature.	16 (10)
	142

In 15 extremities, the SGR was abolished but no increase in the skin temperature was obtained. These must be interpreted as patients in whom the block was effective but where the vascular lesion was dominated by such obstruction to the flow of blood that increase in the blood volume in the extremity concerned could not be achieved on account of obstruction in the main arteries.

In 16 patients, the SGR was not abolished but increase in the skin temperature occurred. In these patients the sympathetic innervation must also pass via ganglia outside the normally situated sympathetic trunk (*e.g.*, in the psoas musculature), so that lasting block with alcohol is not possible.

Result of alcohol block in 100 patients in whom the SGR was abolished and skin temperature rose on test block. (Table 9).

In 84 patients, abolishment of the SGR and raised skin temperature were also obtained. In 14 patients the SGR was not abolished and the skin temperature was not influenced. These 14

Table 9.

Results of Alcohol Block after Effective Test Block.

SGR abolished; skin temperature raised...	84
SGR present; skin temperature raised	2
SGR present; skin temperature unchanged.	14

patients represent blocks in which the sympathetic trunk was not hit. In two cases the SGR was retained but the skin temperature rose. In such cases, the sympathetic trunk was partially affected.

In 65 patients the duration of abolishment of the SGR is compared with the length of the period of freedom from symptoms. (Table 10).

In ten cases only did the SGR remain abolished longer than there was subjective effect in the form of relief of pain, improved ability to walk and sensation of warmth.

In 25 cases, return of the SGR and return of the symptoms occurred at the same time, while in 30 cases, the SGR had returned while the subjective effect of the block was still present.

The duration of the absence of the SGR was from one to 12 months with an average of six months. In only one patient was the SGR abolished for more than a year.

Previous Sympathectomy. Eleven patients had previously been treated by surgical sympathectomy. In three, no record of the SGR is available. In one case no effect was obtained and in two the pain was less and the skin temperature higher following alcohol block.

In eight patients the SGR was controlled. In seven the SGR was abolished prior to test block and alcohol block. Subjective improvement was obtained in six of these patients but increase in the skin temperature could only be demonstrated in four of them. In the patient with the active SGR, this was abolished and the skin temperature rose but there was no effect upon the pain.

Sympathectomy following Alcohol Block. In six patients sympathectomy was undertaken on account of the absence of response to alcohol block.

A male aged 64 years, operated upon a month later. Scar changes around the sympathetic trunk. The operation had no effect.

A male aged 43 years, operated upon five days after the block. The sympathetic trunk was infiltrated with Indian ink for a length of 10–15 cm.

Table 10.

Duration of Abolishment of SGR Compared with Return of Symptoms in 65 Extremities.

SGR present before return of symptoms.....	30
SGR present simultaneously with return of symptoms	25
SGR absent longer than subjective effect	10

No fibres or ganglia were found here. The operation had no effect.

A male aged 73 years, operated upon after three months. Microscopic examination of the specimen from the operation showed the sympathetic trunk with leucocytic infiltration and degeneration of the ganglionic cells. The operation was without effect and the patient was submitted to amputation.

A female aged 50 years, submitted to operation two months later. Microscopic examination showed a normal sympathetic trunk with cicatricial changes around the first ganglion. Operation resulted in moderate improvement of the condition.

A male aged 57 years, operated upon eight days after the block. The sympathetic trunk was found to be situated in the anterior edge of the psoas and the fourth lumbar ganglion was necrotic. Slight increase in the skin temperature and a subjective sensation of warmth were obtained after operation.

A male aged 57 years, operated upon a month after alcohol block. Only a threadlike sympathetic trunk was found from the first lumbar ganglion to the promontory of the sacrum. Some reduction of pain occurred after operation.

CONCLUSION

Blockage of the lumbar sympathetic trunk with alcohol is undertaken because the method is considered to be a lesser intervention than surgical sympathectomy. The intervention is regarded as being without danger if it is undertaken under local analgesia. Under general anaesthesia, a certain mortality must be anticipated on account of the anaesthesia as such.

The intervention may be undertaken in patients in very poor condition and in very old patients. The one essential condition is that the patient can lie still from the moment the needles are introduced until the X-ray photograph is available. The duration of the effect of the alcohol block is approximately six months and the intervention may be repeated. Alcohol block necessitates hospitalization for a few days only. It is not advisable to undertake the intervention in out-patients.

Alcohol block is indicated in all cases in which sympathectomy is indicated. The indications are extended even further as the method is employed in the treatment of phlebitis and in numerous patients in whom age and the general condition together with the obliterating vascular lesion are such that surgical sympathectomy could never have been considered.

Patients with intermittent claudication without pain at rest were found to be well suited for treatment. In patients in whom severe pain at rest was present, the condition frequently remained unchanged and in isolated cases it deteriorated following the block.

In cases with manifest gangrene, the treatment was only indicated if the gangrene was localized to a single toe so that amputation at a higher level was not necessary.

In patients with arteriosclerotic vascular lesions and diabetes, test block should be undertaken as a guide to further therapy. It is to be recommended that test block should be undertaken in all cases. If no effect is obtained after repeated test block, none can be expected after alcohol block.

In phlebitis, for which the previous treatment consisted of daily sympathetic block with short-acting local analgesics (8), this serial treatment may be replaced by alcohol block.

In cases of embolism (12), anticoagulation therapy may be instituted as soon as alcohol block has been established so that a choice of treatment is not forced upon the physician.

In cases of pain in the extremities following laminectomy, it appears that a brief series of ordinary lumbar sympathetic blocks render as good results as alcohol blocks.

Alcohol neuritis only occurred in a severe form in one per cent of the patients which was a low figure. It appeared that the incidence of this complication diminished greatly with the number of blocks that had been performed. All of the severe cases occurred when the physician was learning the technique. This complication is, however, very disagreeable for the patient and although the establishment of alcohol block under local analgesia may be termed an intervention not associated with any danger, it should not be undertaken except by persons thoroughly familiar with the technique of ordinary lumbar sympathetic block with short-acting analgesics.

SUMMARY

483 blocks of the lumbar sympathetic trunk were undertaken with alcohol in 316 patients suffering from pathological conditions in the lower limbs. This intervention proved to be without danger under local analgesia. The duration of the block was about six months and neuritis requiring treatment occurred in one per cent of the cases.

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DIVERTICULUM OF THE FEMALE URETHRA

By PEDER LINNET-JEPSEN

Para-urethral ducts were first mentioned by De Graaf in 1672, but after the publication of Skene's study (31) in 1880, they were given his name. Skene described them as tubular structures running beside the urethra, one on either side, about 1.5 cm in length, and opening on either side dorso-laterally to the external orifice of the urethra. However, studies by Huffman (1948) have shown that there are several such para-urethral ducts (16). In his studies on 11 anatomical specimens, Huffman observed from 6 to 31 ducts. With the urethra as the trunk, these canals—being often 2–3 cm in length—ramified like branches of a tree. Only in two of the 11 specimens did Huffman observe ducts opening on the side of the external orifice of the urethra, *i. e.* as a Skene duct. The epithelium of the ducts is of the same type as in that part of the urethra from which it arises, *i. e.* transitional epithelium in the upper two thirds and stratified squamous epithelium in the lower third. In the terminal parts of the ducts there are often clear cuboidal mucus-producing cells. It has been discussed whether it would be justified to consider these cellular elements as glands (4, 5). Para-urethral ducts are chiefly found in the middle and lower thirds of the urethra, and most of the ducts communicate with the urethral lumen dorsally or laterally. Occasionally, Huffman observed dilatation of the terminal portions of the ducts and slight infiltration with lymphocytes and plasma cells in the surrounding structures.

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AETIOLOGY

Opinions vary as to whether urethral diverticula are congenital (2, 5, 13, 19, 20, 26) or acquired (7, 10, 16, 24, 35). The importance of traumata, especially those of obstetrical origin, has also been discussed (5, 7, 10). The occurrence of urethral diverticula in nulliparae has been interpreted as evidence in support of the assumption that they should be of congenital origin (2), and so has the histological demonstration of the presence of all layers of the urethra—in particular, all the muscular layers—in the diverticular wall (13, 26).

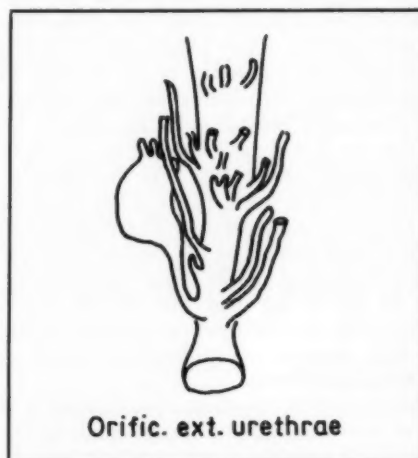


Fig. 1.

The Urethra with Para-Urethral Ducts
(after Huffman (16)).

Johnson's case of a urethral diverticulum in a newborn infant has often been cited, but it was actually a cyst which did not communicate with the urethra (20). In the case reported by Jarecki in 1915, a 21-year-old woman revealed a subvesical sacular dilatation of the urethra—not a diverticulum (19).

It is difficult to assess the role played by obstetrical trauma. About 80 per cent of the patients have borne children (5, 10), and obstetrical complications have often been reported. Davis & Te Linde (7) expressed the view that childbirth is of no essential aetiological importance. Granberg & Svartholm (10) reported that no less than five of their 25 patients had sustained a trauma to the perineal region during childhood, and that in four of these the symptoms had begun a few days after the accident.

It now seems generally agreed that diverticula of the urethra are acquired, and that they take their origin in the para-urethral ducts (7, 11, 16, 24, 35). The localisation of the diverticula and, especially, their urethral openings—principally in the dorsal or lateral walls of the middle and distal thirds of the urethra, is also in favour of this assumption (10). The mechanism of development seems to be that an infection in the urethra results in stenosis or occlusion of the opening of one or more of the para-urethral ducts, which in turn gives rise to dilatation, retention of secretions and infection of the duct. Stenosis or stricture of the meatus (5, 25) or spasms in the meatal region (10) may perhaps also act as a trigger mechanism in provoking the same pathological changes in the para-urethral ducts. Dilatation and infection of the ducts may result in perforation into the urethra, either through the preformed ducts or secondarily from a peri-urethral phlegmon or abscess (5).

According to this view, a urethral diverticulum is thus a dilated para-urethral duct communicating with the urethra. The term urethral diverticulum has become established in the literature, even though there is neither a true nor a false diverticulum (19, 30).

PATHOLOGY

Histological examination of diverticula removed at operation rarely shows a diverticular wall consisting of all the urethral layers (13, 26). There may be an epithelial lining, the nature of which depends on the localisation (11), and in nearly half of the cases non-stratified muscular fibres are present in varying amounts (10, 11). However, the epithelium is often destroyed by inflammatory processes, so that there is only an abscess cavity with granulation tissue without glands or muscular elements (5, 11, 24).

In about one of every five cases, several diverticula are present, and these may communicate (7). Through a suburethral phlegmon the diverticulum may rupture into the vagina with formation of a urethro-vaginal, or rather a urethro-

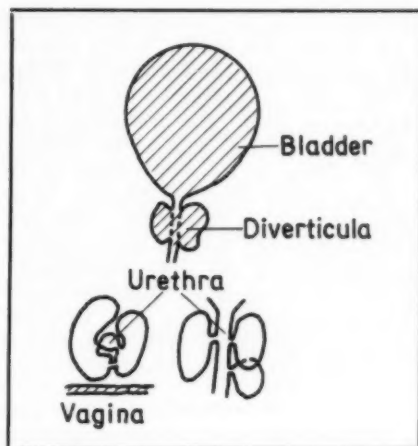


Fig. 2.

Multilocular Communicating Urethral Diverticulum
(after Ingelman-Sundberg (18)).

diverticulo-vaginal, fistula. The diverticula vary from the size of a pea to that of a hen's egg (10, 24, 29). In large series, about two thirds of the diverticula are reported to be more than 2 cm in diameter, and their openings into the urethra are usually 2–5 mm (24, 29, 35). In older literature, the diverticula are reported to contain calculi in nearly one third of the cases. In more recent series, the diverticula are smaller, and the presence of calculi is a rare complication (7).

FREQUENCY

The first case of a urethral diverticulum was described by Hey in 1805. In 1949, about 200 cases were on record (18). Three studies from Denmark are available, reported by Aagaard in 1927 (1), Ottsen in 1942 (28) and Brøbeck in 1951 (3). Aagaard's cases were the first in the world in which urethrography was performed. Under the less fortunate term urethrocele, Ottsen described three cases from Bispebjerg Hospital in 1942. Several series have

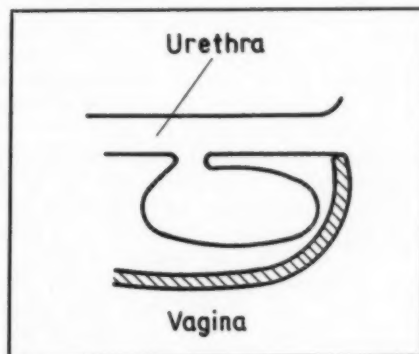


Fig. 3.

Suburethral Diverticulum
(after Ingelman-Sundberg (18)).

been considered in the Scandinavian literature (2, 10, 14, 18, 34); the largest, which consists of 25 cases encountered in Karolinska Sjukhuset during 1940—1957, was reported by Granberg & Svartholm (10). The frequency depends on the attention which is paid to the abnormality (7, 24, 35). Thus, in the Department of Gynecology of the Johns Hopkins Hospital, 50 cases were diagnosed within 12 months (1955—1956), or just as many as had been observed during the preceding 60 years in the same department (7). The largest series available originates from the Mayo Clinic, where 204 cases were encountered during the period 1935—1955 inclusive (Mackinnon, Pratt & Pool (24)).

SYMPTOMS

The frequency of the various symptoms observed in urethral diverticulum appears from Table 1.

Table 1.
Symptoms of Urethral Diverticulum.

	Mackinnon, Pratt & Pool (24)	Davis & Te Linde (7)
No. of cases	204	121
Symptoms		
Dysuria	73%	63%
Frequency of urination	66%	83%
Recurrent urinary-tract infection	46%	20%
Urgency of urination	32%	40%
Incontinence of urine	25%	26%
Haematuria	17%	26%
Dyspareunia	14%	24%
Urinary retention	1 patient	3%
No symptoms	5%	7%

Symptoms of long duration is a characteristic feature in all series on record; one third of the patients had had symptoms for more than 10 years (24). A closer analysis of the symptoms may be used as a guide in diagnosis. The dysuria in urethral diverticulum is usually terminal; it is violent—like tenesmus—and is manifested as pain in the urethra itself (24). The symptoms of dysuria, frequency and urgency of urination simulate urinary-tract infection. In the presence of normal or near-normal cystoscopic findings and normal conditions in microscopy and culture of catheterised urine, further investigations with a view to the possibility of a urethral diverticulum should be performed (5, 19).

The urinary incontinence associated with urethral diverticulum is characterised by a dribbling after the completion of micturition (5, 10, 24). The act of voiding is followed by a burning pain in the urethra and oozing of urine. The burning disappears after the cessation of the dribble—when the diverticulum has emptied, which may require certain movements on the part of the patient (5, 10).

Haematuria is a frequent symptom, possibly because of destruction of the cavernous tissue in the submucosa.

The dyspareunia is of the anterior vaginal type and has in some series been the most frequent symptom (30). Evacuation of the diverticulum during coitus with escape of urine, blood or pus has also been reported (18).

Vaginal discharge is a frequent complaint.

A focus in the urethra may be a good explanation of recurrent urinary-tract infection, but in the presence of a urethral diverticulum the urine is often sterile.

DIAGNOSIS

Most patients with urethral diverticulum are between 30 and 60 years old, the average age being about 40 years (5, 10, 24). The diagnosis is easy in the cases where a mass can be seen or felt in the anterior vaginal wall; such a mass will often be tender. In about two thirds of the cases, digital pressure applied to the mass will result in escape of urine, blood or pus through the external orifice of the urethra and reduction in the size of the mass (7). Palpation of the urethra is best performed against an inserted catheter, which makes it easier to feel any surrounding induration. A sound inserted into the urethra may enter the diverticulum. However, normal palpatory findings will usually be elicited in the presence of an empty non-infected diverticulum.

In urethroscopy, the experienced examiner will be able to discover the openings to the diverticula in nearly two thirds of the cases (7, 10). The instrument of choice is the McCarthy panendoscope, because the opening to the diverticulum is more readily discovered under magnification (7, 9, 10, 24, 25).

Many authors report that great difficulties may be encountered in the urethroscopic examination. Repeated examinations have often been required in order to reveal the diverticular openings (6, 7, 24, 30). A preceding radiographic examination may serve as a guide in the urethroscopy, and the same applies to palpation of the urethra during the endoscopic examination (7, 24).

Since Aagaard's first report (1927) on radiographic examination of the female urethra, many Scandinavian studies on the technique of urethrography have been published (12, 21, 22, 27, 33).

Granberg & Svartholm used Kjellman's instrument in injection urethrography (10, 21). In one of 25 cases the examination proved non-contributory, and in two additional cases there was no diverticular filling, but such typical deviation of the urethra as to suggest a mass dorsal to the lumen. Gullmo (12) devised a special cannula, to the tip of which a metal plate is fixed. The cannula is available with different sizes of metal plate; it is luxated into the urethra. The plate may be wetted with xylocaine gel, while the introduction of this gel into the urethra cannot be advised, since it may fill the diverticulum, if any. However, a certain distortion of the distal part of the urethra can scarcely be avoided in any form of retrograde urethrography (24).

Voiding cysto-urethrography is the easiest, most lenient and most physiological method of examina-

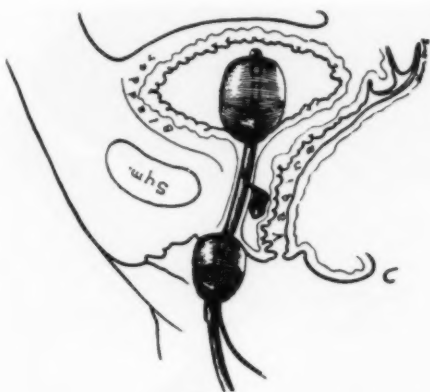


Fig. 4.

Technique of "Positive-pressure" Urethrography
(after Davis and Cian (6)).

tion. However, the method may fail, presumably because the intra-urethral pressure is not always sufficiently high to force the contrast medium through a narrow and, possibly, oedematous opening into the diverticulum. The pressure on the contrast medium may be increased by micturition through Gullmo's cannula (12). In voiding cysto-urethrography, the exposures should always be taken with the patient in the standing position—both in anteroposterior, lateral and oblique projections. Under such circumstances, it will often be difficult for the patient to void. The diverticulum should be emptied before the radiographic examinations (6). Both methods of urethrography should always be given a trial since each of them may be unsuccessful (10).

In 1956, Davis & Cian (6) described a new technique, *viz.*, that of "positive-pressure" urethrography.

By means of a special catheter provided with two balloons, the urethra is closed towards the bladder and the external orifice of the urethra, so that it becomes possible to obtain a relatively high pressure on the contrast medium. Within three months, 12 cases of urethral diverticulum were diagnosed (6), and the method was unsuccessful only in two out of 64 cases (23). In these two series, the diverticula were small, and only rarely was it possible to make the diagnosis by clinical examination.

Several investigators prefer "diverticulography" (24, 32). Through an endoscope a ureteral catheter No. 4 is inserted into the diverticular orifice. The catheter should be placed in warm water for a short time before use; it then becomes so soft and pliable that it will coil in the cavity of the diverticulum. This method of examination proved successful in one half of the cases (24).

Oil-containing contrast media were formerly used (1, 33), but now aqueous solutions, varying in concentration and viscosity, are employed (10). Studies on the retention of radio-opaque material in the diverticula have not been performed, but such studies would surely be useful in the differentiation between small diverticula and physiologically dilated para-urethral ducts.

DIFFERENTIAL DIAGNOSIS

A urethral diverticulum is often mistaken for a cystocele or urethrocele, especially when the

patient has a sense of fullness in the vagina, and when the clinical examination reveals a mass in the anterior vaginal wall. However, the bulging of the anterior vaginal wall will scarcely be so wide and diffuse as in the presence of a cystocele or urethrocele, and the patient will often state that the vaginal mass is only intermittently present.

Cysts and tumours between the urethra and vagina are relatively rare. The cysts are believed to develop from the Wolffian and Müllerian ducts (11). Endometriosis has repeatedly been reported (34). Malignant tumours of the urethra have been reported in more than 600 cases; most of these tumours were epitheliomata which had arisen from squamous or transitional epithelium (11)—in one case in a diverticulum (36). Adenocarcinoma of the urethra has been reported in only about 30 cases, once in a diverticulum (13).

TREATMENT

Experience has shown that conservative treatment does not lead to satisfactory results. Several authors have used dilatation of the meatus (5, 10, 25) or transurethral dilatation of the opening of the diverticulum (5). However, most writers recommend surgical treatment in symptom-producing diverticula (5, 10, 24, 32). In acute cases associated with abscess formation or severe inflammatory infiltration, the surgical intervention should consist in simple incision. If the opening of the diverticulum is closed, and the epithelium in the diverticulum is destroyed, this treatment will suffice (5, 32). Otherwise, a urethro-vaginal fistula will develop, but experience shows that such a fistula does not produce symptoms if it is situated distal to the proximal $1\frac{1}{2}$ cm of the urethra.

The rational intervention consists in extirpation of the diverticulum. A catheter should be inserted into the urethra and, if possible, a sound or a ureteral catheter into the diverticulum. The diverticulum is isolated through a colpotomy, care being taken to inflict a minimum of injury on the musculature and fascia (24, 32). The opening of the diverticulum is sutured with catgut, preferably across the longitudinal axis of the urethra (32). The urethra is closed with two layers of catgut sutures. In the presence of large defects, plastic surgery with muscle reinforcement is advised (10, 17, 18, 24). Edwards & Beebe recommended splitting of the urethra up to $1\frac{1}{2}$ cm from the internal orifice in order to facilitate a general survey of the conditions. The urethral catheter should be allowed to remain in place for eight to ten days after operation. Postoperative haemorrhage is not rare (24).

A detailed pre-operative clarification of the anatomical conditions is important, since there may be several diverticula, and one of these might then be overlooked at operation. It is also important that extirpation is postponed until the inflammatory infiltration has subsided, since the

isolation will otherwise be difficult and the destruction of muscular tissue greater—with enhanced risk of postoperative stress incontinence and fistula formation (32).

Few follow-up studies are available (7, 8, 10, 24). In 84 operations, Davis & Te Linde (7) had 10 recurrences, five of which produced symptoms. Granberg & Svartholm (10), of Karolinska Sjukhuset, performed radiographic and urethroscopic follow-up studies on 17 patients subjected to operation. Nine of the 17 patients were symptom-free, but two of these revealed recurrence, and one patient had a urethro-vaginal fistula. Eight patients had still symptoms, five with recurrence and three with fistula formation. Thue, radiographic examination revealed recurrence in seven of the 17 patients, but only in two of these was the orifice of the diverticulum visible in the urethroscope. Eleven of the 17 patients had postoperative stress incontinence.

PRESENT SERIES

The present series consists of 12 patients, *viz.*, two from the State Maternity Hospital for Jutland and 10 from Aarhus Amtssygehus; the latter 10 were diagnosed within 18 months.

The ages of the patients ranged from 20 to 66 years and averaged 44 years. Nine of the 12 patients had borne children. No complications had been encountered in a total of 20 deliveries. In one patient, the symptoms were first noticed after a birth. None of the patients had previously sustained any known trauma. One had previously suffered from a Neisserian infection.

Symptoms.—Six of the patients had had symptoms for less than six months, two for 1—5 years, and four for more than five years. Four patients were admitted for prolapse of the uterus, including one with recurrent prolapse. One was



Fig. 5.
Voiding Cysto-urethrogram.



Fig. 6.
Injection Urethrogram by the Method of Gullmo (12).

admitted for cancer of the cervix uteri, stage IV, an infiltration in the anterior vaginal wall being interpreted as a metastasis. The remaining patients were admitted with a tentative diagnosis of cervicitis or cystitis, including one with acute urinary retention.

Nine of the 12 patients had had symptoms from the urinary tract in the form of infection, dysuria, frequency or urgency of urination. Four complained of urinary incontinence in the form of dribbling after micturition; one of these also suffered from stress incontinence. Haematuria was present in one patient. Seven patients complained of anterior vaginal dyspareunia; in one of these pus escaped during coitus. Five were troubled by vaginal discharge, including three in whom this was the principal complaint.

These patients had for months or years been treated for cystitis, cystalgia and recurrent vaginal discharge with antibiotics, vaginal suppositories or short-wave therapy.

Diagnosis.—In eight of the 12 patients, a mass, induration or tenderness in the anterior vaginal wall was disclosed; in four of these palpation of the urethra caused escape of purulent material from the external orifice. In four patients the diagnosis was made by urethrography. Voiding cysto-urethrography and injection urethrography by the method of Gullmo were performed in nine of the patients. Local anaesthesia was usually employed, and the external orifice of the urethra was closed by a Michel agraffe in order to prevent reflux during the injection. Now we perform cysto-urethrography during micturition through the Gullmo cannula. The contrast medium was aqueous (Diodone, 17 per cent), but it might be an advantage to use a slightly more concentrated and more viscous medium. In three

of the nine cases, both voiding cysto-urethrography and injection urethrography were unsuccessful. In two of these patients, the diagnosis was confirmed by operation. In the third patient, a woman aged 38, the symptoms were suggestive of a urethral diverticulum, and the suspicion was confirmed by the clinical examination. She was subjected to urethroscopy twice and to voiding cysto-urethrography and injection urethrography twice—also with "positive-pressure" technique. However, this patient has not as yet been subjected to operation because a sufficiently accurate pre-operative diagnosis has not been secured, and because some inflammatory infiltration still persists.

Urethroscopy caused difficulties and has so far not been of diagnostic value in our hands.

Now we use the McCarthy panendoscope in urethroscopy.

Treatment.—Six of the 12 patients have undergone operation, *viz.*, incision in two and extirpation in four. In two cases, an abscess was present on admission. In both incision was performed, with evacuation of ample amounts of purulent material.

One of these patients, a woman aged 61, also suffered from inoperable cancer of the sigmoid, for which palliative colostomy was performed. She died 9 months after the incision without recurrent symptoms from the diverticulum. Autopsy revealed a



Fig. 7.

Recurrent Diverticulum after Extirpation.



Fig. 8.

Plain Radiograph of the Urethral Region.

pea-sized diverticulum without surrounding inflammatory infiltration or fistula formation. The second patient, a woman aged 36, had only mild symptoms after the incision and no signs of fistula formation. Voiding cysto-urethrography performed six months after the incision showed a relatively large diverticulum of the urethra (Fig. 5). Injection urethrography by the method of Gullmo (Fig. 6) revealed that it was multilocular with two communications to the urethra. The patient refused operation.

The second case illustrates the well-known fact that injection urethrography gives the most detailed information as to the localisation and anatomy of the diverticula.

One patient has been symptom-free for 11 years after incision of a periurethral abscess, but mild symptoms have now developed. Clinical examination has revealed a small urethro-vaginal fistula, and urethrography has disclosed a small diverticulum.

Extirpation was performed in four cases. In 1956, a multilocular communicating diverticulum was removed in a 38-year-old woman; she is now symptom-free, but the diverticulum has recurred (Fig. 7).

The remaining three patients underwent operation eighteen, six and two months ago. They are now symptom-free, and urethrography has not revealed any signs of recurrence in the first of these patients.

Figures 8 and 9 are radiographic exposures from a woman, aged 57, with a large calculus in an urethral diverticulum. This patient has suffered from recurrent cystitis for 40 years. Like two other patients, she has refused operation because she has only relatively mild symptoms. In view of the possibility of postoperative recurrence and stress incontinence we do not want to bring pressure to bear upon these patients.



Fig. 9.

Voiding Cysto-urethrogram.

Pathology.—The four removed diverticula ranged from the size of a hazelnut to that of a pigeon's egg, and two of them were multilocular. Histological examination of three of the specimens showed that the diverticular wall consisted of fibrillar connective tissue with variable amounts of non-striated muscular tissue. The stratified squamous epithelium was destroyed in certain areas. All layers showed infiltration with lymphocytes, plasma cells and polynuclear leukocytes. Glandular tissue was not unquestionably demonstrated.

SUMMARY

On the basis of the literature a survey is given of the clinical picture of diverticulum of the female urethra. The diverticula take their origin from the para-urethral ducts. The disease is not at all rare. The symptoms serve as a guide in the diagnosis. The possibility of an urethral diverticulum should be borne in mind in women with recurrent "cystitis," atypical incontinence of urine, anterior vaginal dyspareunia of intermittent vaginal discharge. The diagnosis is often suggested by palpation of the anterior vaginal wall. Urethroscopy should be performed, preferably by means of the McCarthy panendoscope. The most important method of examination is urethrography, which should be performed both as voiding cysto-urethrography and as injection urethrography. These methods may fail and may therefore have to be repeated. In cases with severe inflammatory infiltration incision should be done. Extirpation must be advised in chronic symptom-producing cases. However, the frequency of recurrence is relatively high, and there is a risk of postoperative stress incontinence and fistula formation. In order to spare the urethral muscula-

ture, careful dissection is necessary, for which reason operation should be postponed until the inflammatory reactions have subsided. Mention is made of 12 cases, of which 10 were diagnosed within 18 months in a department of general surgery.

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PULMONARY RESECTION FOR TUBERCULOSIS IN GREENLAND

PRELIMINARY RESULTS OF THE FIRST 478 RESECTIONS IN THE COURSE OF FOUR YEARS

By **PALLE NØHR**

Queen Ingrid's Sanatorium in Godthåb was inaugurated on Oct. 30, 1954. The necessity of surgical interventions (pulmonary resections) instead of collapse therapy in the treatment of pulmonary tuberculosis was soon recognized (1). A specialist in pulmonary surgery (Ole Storm and later Per Juul Martiny) was appointed to the sanatorium and pulmonary resections were commenced from Jan. 1, 1956. In July 1957, a central surgical department for Greenland was instituted in the sanatorium. This department took over the thoracic surgical treatment of pulmonary tuberculosis. The patients received the specific preliminary treatment in the department for tuberculosis and were transferred to the surgical department immediately prior to the planned operation where they remained for four weeks after the operation had been carried out. The decision for surgery was always made by surgeon and physician together.)*

The following is an account of the pulmonary resections for tuberculosis carried out in the four-years period from Jan. 1, 1956 through Dec. 31, 1959.

PREOPERATIVE DATA

The material comprises 478 resections. In 372 patients unilateral resection was undertaken and in 53 bilateral resection in two sessions. Re-resection was not undertaken. The number of patients submitted to pulmonary resection was thus 425 and, of these 12.5 per cent were submitted to bilateral resection.

Table 1 shows the age and sex distribution.

Table 1.
Age and Sex.

	Total	10-14	15-19	20-29	30-39	40-49	50-59	60-69 Years
Females	234 (55%)	6	35	81	62	39	10	1
Males	191 (45%)	5	29	63	39	39	15	1
	425	11	64	144	101	78	25	2

There was a moderate preponderance of females. The age of puberty was regarded as an aggravating indication and, for this reason, there are relatively many patients in the agegroup

*) For excellent cooperation I want to thank Dr. K. S. Stein, Dr. Ulf Gad, and Dr. P. Krebs Lange.

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10-19 years. The two oldest patients were aged 63 and 64 years of age, respectively, and bilateral resection was undertaken in one of them. Otherwise, the majority of the patients were aged from 20 to 50 years.

The interval between the diagnosis of the pulmonary tuberculosis and the operation undertaken appears from Table 2.

Table 2.
Preoperative History.

< 1 Year	1-3 Years	> 3 Years
145	130	150

Only objective criteria such as the results of the examination of the sputum or the X-ray findings form the basis of the diagnosis. This subdivision is, quite arbitrary. A history of three years or more may thus mean, in many cases, a ten-year history of tuberculosis.

As Table 3 shows, 26 per cent of the patients had previously received conservative therapy for tuberculosis prior to the present admission and operation. Brief (frequently out-patient) chemotherapy is not included but only courses of chemotherapy undertaken together with a regular sanatorium regime.

Table 3.
Previous Treatment.

Conservative treatment (Including chemotherapy)		109
Pneumothorax	} ipsilateral	53
Thoracoplasty		6
Plombage		1
Thoracoplasty	} contralateral*)	9
Lobectomy		1
Plombage		2

*) Pneumothorax not included.

During the present period of hospitalization, all of the patients received chemotherapy for a varying number of months prior to the pulmonary resection, approximately 81 per cent of them for four months or longer (cf. Table 4).

Table 4.
Preoperative Chemotherapy.

Less than four months	Longer than four months
80 patients	345 patients

Courses of triple chemotherapy with izoniacid, aminosalyl sodium and duostreptomycin comprised the standard treatment. Frequently, the standard treatment was supplemented with other drugs such as cycloserine, pyrazinamide and viomycin, e.g. in resistant cases which had previously received the ordinary course of triple chemotherapy for a prolonged period.

The results of examination of the sputum for mycobacterium tuberculosis (direct microscopy and/or culture) during the preoperative period are recorded in Table 5. In 88 per cent of the

Table 5.
Preoperative Examination of Sputum in the 425 Patients.

Never positive sputum	89
Negative sputum for more than 3 months pre-operatively	284
Positive sputum for less than 3 months pre-operatively	52

patients, negative results had been found for three months or longer prior to the operative intervention.

The operative X-ray findings and, therefore, the radiological indication for resection appears from Table 6. This quantitative subdivision is based upon antero-posterior tomography recorded, at the longest, six weeks prior to operation.

Table 6.
Preoperative Radiographic Findings.

Irregular infiltration (frequently with small areas of collapse)	86
Tuberculomata or filled cavities	164
Cavities	218
Destroyed lung	10

Radiological differentiation between tuberculomata and filled cavities is frequently difficult and, therefore, the two diagnoses are recorded together. The differential diagnosis between nodular tuberculous infiltration and pulmonary cancer did not, as a rule, cause any difficulty as cancer of the lung (primary) is an extremely rare condition in Greenland. Within the four-year period covered by this material, no pulmonary resection was carried out for cancer. A further indication than those recorded was chronic tuberculous empyema with associated processes in the homolateral lung. Fifty-two per cent of the patients had bilateral infiltrations. In the majority of the cases, only vague inactive processes on the non-operated side were concerned. The monolateral cases were equally distributed between the right and the left sides.

Diagnostic bronchoscopy was undertaken pre-operatively in 93 per cent. Pathological changes

were only encountered in 13 per cent of the bronchoscopies. The most frequent changes were healed bronchial fistulae and next bronchostenosis. Six patients were found to have tuberculous bronchitis and these were treated with PAS inhalations in addition to the routine triple chemotherapy.

Preoperative bronchography was only undertaken in exceptional cases. This was also the case with bronchspirometric investigations. Occasionally, simple measurements of vital capacity and measurements of the excursions of the diaphragm were employed to evaluate the pulmonary function.

The general clinical condition of the patients prior to operation was, by and large, good: the sedimentation rate was low or falling, the temperature normal, the sputum scanty and there was no dyspnoea at rest.

OPERATIVE DATA

The various types of pulmonary resection are recorded in Table 7. The grouping is undertaken according to the most important resection undertaken e.g. in a number of cases with lobectomy, segmental resection or cuneiform resection were also undertaken.

Table 7.
Pulmonary Resections.

Pneumonectomy	14
Lobectomy	45
Upper lobe	41
Middle lobe	3
Lower lobe	1
Segmental resection	282
1 Segment	187
2 Segments	83
3 Segments	12
Subsegmentectomy	8
Cuneiform resection	129
Total resections	478

Removal of one segment was thus the most frequent form of operation. Next in frequency was the wedge resection and, thereafter, resection of two segments. In the majority of cases, the site of the tuberculous lesion was the apico-posterior segment of the upper lobe.

Simultaneously with the resections carried out, various "spacereducing procedures" were undertaken: extra-periosteal plombage in three lobotomies, parietal apical pleurolysis in seven cases and intrathoracic phrenicocolysis in 49 cases.

Concomitant thoracoplasty was, on the other hand, not employed. Finally, extensive decortication of the lung was undertaken in seven resections.

PATHOLOGICAL FINDINGS

The dominating morphological change in the resected pulmonary tissue is shown in Table 8.

Tuberculomata were characterized by sharply delimited foci containing caseous masses which were difficult to scrape off and frequently containing small areas of collapse. Filled cavities, on the other hand, contained detritus which was

Table 8.
Pathological Findings.

Tuberculoma	178
Tuberculoma + cavities	152
Cavities	88
Filled cavities	43
Fibrosis	8
Bronchiectasis	4
Atelectasis	1
No definite tuberculous changes	4
Number of specimens	478

easily scraped off. No histological differential diagnosis was undertaken in this material. The bronchiectatic changes were localized to the upper lobe or to the apical segment of the lower lobe and were, therefore, regarded as being of tuberculous etiology and not non-specific.

Only a minority of the preparations were submitted to histological examination.

Bacteriological investigation for mycobacterium tuberculosis by culture on Loewenstein-Jensen's medium was undertaken on 441 preparations. Forty-three of these or approximately ten per cent, were positive.

MORTALITY AND COMPLICATIONS

In this material, the operative mortality is taken to mean all of the deaths which occurred during operation and the first four weeks after operation. Within the period of observation of this material which comprizes a total of six months, further deaths occurred.

Seven of the patients died, giving an operative mortality of 1.5 per cent (calculated from the number of resections).

1) Female aged 36 years. Transferred as hopeless from a sanatorium in Denmark. Bilateral cavities. Sputum $\frac{1}{4}$ litre daily. High pyrexia. Repeated haemoptyses. Resistant to triple antibiotic therapy. Right extra-pleural pneumothorax had been undertaken but without resulting closure of the cavities. An attempt at right extra-pleural pneumonectomy was undertaken but massive haemorrhage and shock occurred and terminated fatally.

2) Male aged 44 years. Operation revealed arteriovenous aneurysms in the upper and middle lobes. Haemorrhagic shock occurred and death took place on the fifth postoperative day. (Quoted by Martiny ¹).

3) Female aged 41 years. Right upper lobectomy which proved technically very difficult. Violent haemorrhage from repeated vascular lesions. Death from haemorrhagic shock on the first postoperative day.

4) Female aged 23 years. Left pneumonectomy. During the intervention considerable transient haemorrhage occurred. Shock and respiratory insufficiency occurred and did not respond to therapy. Death after 24 hours.

5) Female aged 21 years. Easy and uncomplicated segmentectomy. Immediately after the operation a massive air embolism occurred from the transfusion set with positive pressure. Instantaneous death.

6) Female aged 36 years. Left-sided segmentectomy I + II + III with pleural decortication. A prolonged and difficult intervention. At the conclusion of the operation, cardiac arrest occurred which did not respond to therapy. According to subsequent investigations, this was perhaps due to evaporation shock on account of the extreme dryness of the air in the operating theatre.

7) Female aged 20 years. Left segmental resection. The intervention was easy and rapid. Blood loss 325 ml. At the conclusion of the operation respiratory insufficiency occurred and haemorrhagic diathesis with violent haemorrhage from the intestine, genitalia, skin and conjunctiva and under the parietal pleura. Tracheostomy and artificial respiration were required. The specialist anaesthetist who was summoned considered that inadequate soda-lime in the anaesthetic machine had probably been the cause of CO₂ accumulation.

All seven deaths occurred during or in direct connection with the operation. Case No. 1 must be termed a "desperate risk" and probably should not have been submitted to operation. As regards cases Nos. 5, 6 and 7, should be recorded that it was probably not the intervention as such but the conditions under which it was undertaken which caused the death. It is possible that similar evaluation of the remaining cases Nos. 2, 3 and 4 may be undertaken. In this connection, it may be noted that all of the deaths occurred before an anaesthetist was appointed to the department.

The most important non-fatal complications in the postoperative period are recorded in Table 9. The period of observation was six months as these patients were submitted to a postoperative medical regime including chemotherapy for six months. Further, it is stated that the complications following pulmonary resection occur predominantly during the first six months (2).

Residual air (airleak, space problem) without recognized bronchopleural fistula or accompanying specific or non-specific empyema occurred after 64 resections. In six patients, thoracoplasty was undertaken at a later date for this reason. Forty-two patients were treated with closed drainage and suction. In one patient, re-thoracotomy with parietal apical pleurolysis was undertaken and, finally, cervical phrenicoplasty was

undertaken in one case. On discharge, 17 patients had a little apical pneumothorax which was symptomfree.

Bronchopleural fistula was recorded in 14 cases and was most frequent following segmental resection. This complication did not occur at all following pneumonectomy. Concomitant empyema was found in four cases (non-tuberculous in three cases and tuberculous in one case). In half of the patients with fistulae, thoracoplasty was undertaken at a later date and five of these within the period of observation of six months and two cases two end three years, respectively, after the resection. Re-section was not undertaken on account of fistula formation. In four patients, the fistula closed after closed drainage and suction and in three patients the symptoms of fistula disappeared following conservative therapy.

Postoperative atelectasis occurred in 10 per cent and was relatively more frequent following lobectomy. Approximately $\frac{1}{3}$ of the cases of atelectasis were on the contralateral side. In half of the cases, atelectasis was relieved by therapeutic bronchoscopy and otherwise by means of pulmonary physiurgic therapy. No late sequelae occurred after this complication.

Haemothorax occurred in four patients. All of these were following cuneiform resection. In one case, re-thoracotomy was undertaken and in the remainder, repeated thoracocenteses with aspiration. Injections of streptokinase or streptodornase were, on the other hand, employed.

Temporary nerve lesions were registered in nine cases (Hörner's syndrome 4, radial nerve palsy 3 and paralysis of the vocal cords 2).

Postoperative psychoses developed in eight patients or 1.7 per cent. In all of the cases, the psychoses made their appearance following a latent interval of approximately 24 hours.

Four patients have again begun to secrete bacilli within the period of observation of six months. In three of these patients, radiographic changes (spread or re-activation) were also present.

DISCUSSION

The geographical and social conditions (remotely situated villages inhabited by a few families,

poor housing and living conditions) make treatment of the extensive pulmonary tuberculosis in Greenland difficult. Out-patient treatment (chemotherapy and collapse therapy) can frequently not be carried out for the above-mentioned reasons. On the other hand, pulmonary resection preceded by courses of chemotherapy appears to be suitable. The mortality and the incidence of complications are today slight with this combination therapy in the period of hospitalization is considerably shortened (3, 4). The incidence of operation has also increased steadily since the inauguration of the sanatorium and was approximately 50 per cent in 1950 where pulmonary resections are concerned. As with other materials (5) all forms of collapse therapy have diminished recognizably during the same period.

Prolonged preoperative antituberculous chemotherapy is necessary to reduce the incidence of complications (6). The majority of the patients in this material received triple chemotherapy for four months or longer and the treatment was continued for an average of six months in hospital.

Alle of the resections were carried out in the lateral position. The problem of secretion was negligible as a quantity of sputum of less than 20 ml daily was aimed at. All of the patients received general anaesthesia. The ordinary operation technique was employed with insignificant modifications (7, 8, 9). The presenting rib, as a rule the fourth or fifth, was resected subperiosteally for a length of approximately 20 cm via a postero-lateral incision. Only in young individuals (under the age of 20 years) was rib-resection omitted and the pleura incised intercostally. All of the pleural adhesions were divided to permit meticulous palpation of the lung and to render its expansion possible after resection. Individual hilar dissection was employed except in cases with large INH cysts were initial peripheral dissection was preferable (10). The resections were "radical" in so far that an attempt was always made to resect alle macroscopic foci. The bronchial stump was sutured according to Jens L. Hansen's method (personal communication). Pleuralization of the hilus was undertaken routinely in pneumonectomies. This was not always

Table 9.
Non-Fatal Complications.

Operation	No.	Residual air	Bronchopleural fistula	Atelectases	Haemothorax
Pneumonectomy	14	—	0	0	0
Lobectomy	45	8 (18 %)	1 (2 %)	9 (20 %)	0
Segmentectomy (+ subsegment.)	290	54 (19 %)	12 (4.1 %)	29 (10 %)	0
Cuneiform resection	129	2 (1.6 %)	1 (0.8 %)	11 (9 %)	4
Total	478	64 (14 %)	14 (2.9 %)	49 (10 %)	4 (0.8 %)

the case with other forms of resection where the secondary or tertiary hilus was, however, often covered with lung tissue. Similarly, no attempt was made to pleuralize the raw surface. Drainage was employed after all resections. Following pneumonectomy a rubber drain without suction was employed. In the other resections, upper and lower drains with 10 cm water suction were used. According to the function of the drains (removal of air and secretion) these were removed 48–72 hours postoperatively. Both before and after operation each patient received individual pulmonary physiurgic therapy.

Concomitant space-reducing measures (apart from phrenicoclasia) were carried out in a limited number of cases (cf. above). No such measures were employed at all in segmental resections (11, 12). Phrenicoclasia was employed to some extent both with decreasing frequency. In the postoperative course, thoracoplasty (as a rule osteoplastic thoracoplasty by Høist's or Børk's methods) was employed for complications such as bronchopleural fistula or persistent pneumothorax (a total of 13 patients).

The operative mortality in the present material is 1.5 per cent. This corresponds to the average mortality obtained by various authors, many of whom emphasize the falling mortality with the improvement of the technical routine (4). In the year just concluded, 150 pulmonary resections were undertaken without any operative mortality in this sanatorium.

The same conditions hold true for the other complications. The character of these complications does not change but the incidence falls from year to year. This is most pronounced in the case of bronchopleural fistula and empyema (13).

A frequent complication in this material was postoperative psychosis (14). There were no deaths from this complication and it lasted for only a few days.

SUMMARY

A material of 478 pulmonary resections for tuberculosis carried out during a four-year period in Queen Ingrid's Sanatorium, Godthåb, Greenland, is presented. The preoperative conditions and the mortality and complications are reviewed. The postoperative period of observation was only six months.

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THROMBOCYTOPENIC PURPURA COMPLICATING INFECTIOUS MONONUCLEOSIS

By P. ANTHONISEN, O. STEINICKE & A. C. THOMSEN

Moderate thrombocytopenia is not very uncommon in infectious mononucleosis (11, 19, 24). Nor are slight haemorrhagic complications such as epistaxis and rectal haemorrhage (24, 25). Severe thrombocytopenia (les than 50,000 per microlitre) with purpura and/or severe haemorrhage from the urinary or alimentary tracts has, on the other hand, only been described on a few occasions in the literature as a complication of mononucleosis (1–10, 12–18, 20–23, 26, 27). The authors were only able to find reports of 26 such cases and therefore briefly report a further case.

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CASE HISTORY

A boy aged seven years was admitted to hospital on account of violent epistaxis following fatigue, malaise, swelling of the eyelids and neck and pyrexia of approximately 39° C (102.2° F) for a few days. On admission, the patient was ill but not shocked. The temperature was only slightly raised. There was continual haemorrhage from the nose and mouth and petechiae and purpuric elements on various parts of the skin and mucous membranes. The tonsils were slightly enlarged but without acute changes. Moderate generalized adenitis was present and in the neck isolated enlarged lymphatic glands with surrounding oedema were observed. The tip of the spleen could be felt under the rib margin.

Laboratory investigation revealed thrombocytopenia (3,000 per microlitre), prolonged bleeding time (> 1

hour), slightly prolonged coagulation time (9 minutes), prothrombin index 64 per cent, and haemoglobin concentration of 12.6 g/100 ml. The serum creatinin concentration was normal (0.9 mg/100 ml). The leucocyte count was 9,500 per microlitre. The clinical picture was suggestive of leucosis but a preliminary investigation of a smear from the peripheral blood did not support this.

The patient was treated with penicillin and prednisone and blood transfusion when signs of commencing circulatory shock developed. During this treatment, the clinical condition improved rapidly. The haemorrhagic tendency (continual haemorrhage from the nose, mouth and sites of injection and macroscopic haematuria) disappeared in the course of a few days. Six days after admission, while the patient was still subfebrile, tonsillitis with large follicular tonsils which were the site of small haemorrhages and large cream-coloured membranes was demonstrated. The blood smear made at the commencement of the disease was re-examined and revealed a picture characteristic of mononucleosis. Differential blood count from the peripheral blood taken on the third day of the illness showed, on counting 200 cells: metamyelocytes 8 per cent, polymorph granulocytes 29 per cent, eosinophile leucocytes 0 per cent, basophile leucocytes 0.5 per cent, typical lymphocytes 8.5 per cent, atypical lymphocytes 12 per cent, atypical monocytes 8 per cent, typical "mononucleosis cells" 34 per cent. The lymphocytic monocytic elements revealed a somewhat mixed picture both with typical mononucleosis cells with circular vacuoli and diverse monocyte precursors such as monoblasts, promonocytes and isolated giant monocytes and typical small lymphocytes. A positive thymol reaction, slightly raised serum transaminase value and a high gamma globulin value supported this diagnosis although the Paul-Bunnell reaction was negative.

The tonsillitis and lymphadenitis gradually disappeared and the treatment with penicillin was withdrawn. The spleen was only palpable for a few days. The dosage of prednisone was stepped-down in the course of a week. The thrombocyte count increased and, on the ninth day of the illness, it had returned to normal (336,000). A bone-marrow puncture taken seven days after admission revealed hyperplastic marrow with displacement of myelopoiesis to the left without signs of systematic disease.

Three weeks after admission, the patient felt well and the blood picture was normal.

On control examination, eight months after discharge, the patient was still well. Objective examination did not reveal any abnormality. The peripheral blood picture was normal and the thrombocyte count 340,000.

DISCUSSION

The diagnosis of infectious mononucleosis must be regarded as definite in this patient. In addition to enlargement of the lymphatic glands, tonsillitis and enlargement of the spleen, a characteristic blood picture was present. Further, signs of involvement of the liver were present. Admittedly, the Paul-Bunnell reaction was negative but this reaction is not essential for the diagnosis, particularly not in children (24).

The haemorrhagic diathesis manifested itself immediately after the commencement of the illness in the form of petechiae, purpura, epistaxis and macroscopic haematuria. The haemorrhage was so marked that signs of commencing circulatory shock were observed. No signs of nephritis were observed, the renal function being unaltered and the urine normal when the haematuria had disappeared. Examination of the blood revealed the cause of the haemorrhage to be a low thrombocyte count (minimum 3,000). Corresponding to this, the bleeding time was considerably prolonged.

Various hypotheses have been propounded to explain the nature of the thrombocytopenia in infectious mononucleosis. Dameshek & Grasse (1946) (4) attributed this to hypersplenism and caused the haemorrhagic diathesis to disappear following extirpation of the spleen. Their patient, however, had had increased bleeding tendency for two years previously. Other authors have suggested a toxic effect upon the thrombocytes (18) or thrombocyte loss resulting from vascular injury (10) or the thrombocytopenia was interpreted as an allergic reaction to an acute infection (3, 15). Formation of a thrombocyte agglutinating factor in the blood may be considered. Freeman & Wakefield (7) demonstrated, in the blood of a patient with infectious mononucleosis, who had, in addition, jaundice and thrombocytopenia, a substance which agglutinated blood platelets. This factor was not identical with the heterophile antibody which forms the basis of the Paul-Bunnell reaction.

Various authors have stated that treatment with steroids was effective against the thrombocytopenia (3, 5, 7, 9, 16, 22). It appears, however, from the literature that patients recover just as well without steroid therapy which thus does not appear to be decisive for the prognosis. Splenectomy need only be considered in the cases where true hyperplenism can be demonstrated. The prognosis in the disease is good and no deaths occurred among the 26 patients mentioned in the introduction. In all of the cases, the thrombocytopenia disappeared in the course of a few weeks.

SUMMARY

Moderate thrombocytopenia and slight haemorrhagic complications are frequently observed in infectious mononucleosis. Dangerous haemorrhage on account of pronounced thrombocytopenia is, on the other hand, a complication which has rarely been described in this condition. Such a case occurring in a boy aged seven years is reported.

The pathogenesis of the thrombocytopenia in infectious mononucleosis is unknown.

The prognosis is good and independent of any steroid therapy instituted.

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MEDICO-STATISTICAL INFORMATION FROM DENMARK FOR THE YEARS 1958 AND 1959

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Table 1.

Population:			Notifiable diseases:*)	
Census October 1st, 1955:	4,448,401		1959	977,939 = 215 per 1,000 population
Estimated, July 1st, 1959:	4,546,600		1958	698,862 = 155 per 1,000 population
Live-born:	1959	73,928 = 16.3 per 1,000 population	December 31st, 1958:	
	1958	74,681 = 16.5 per 1,000 population	Practising physicians:	5,526 = 1 per 817 inhabitants
Still-born:	1959	1,095 = 1.5 per cent of total births	Dentists with own practice:	1,482 = 1 per 3,047 inhabitants
	1958	1,173 = 1.5 per cent of total births	Pharmacies:	353 = 1 per 12,790 inhabitants
Deaths	total	1959	42,159 = 9.3 per 1,000 population	Practising midwives: 672 = 1 per 1,588 women
		1958	41,560 = 9.2 per 1,000 population	in the age group 15-49 years
	under 1 year	1959	1,660 = 22.5 per 1,000 live-born	
		1958	1,675 = 22.4 per 1,000 live-born	

*) Except venereal diseases, delirium tremens and scabies.

The information in Table 1, together with that of Table 2, showing the number of reported cases of epidemic diseases, indicates an increase of about 40 per cent in the epidemic morbidity from 1958 to 1959, mainly due to influenza of which 367,553 cases were reported in 1959 against 167,144 in 1958.

A total of 27 cases of acute anterior poliomyelitis was notified in 1959, namely 11 paralytic and 16 aparalytic cases, as against 94, 66 and 28 respectively in 1958. Only 13 cases of poliomyelitis, hereof 6 paralytic, have been reported within the first 10 months of 1960. During the last 5 years

only two deaths from poliomyelitis have been reported.

The slightly decreasing tendency in the number of reported cases of gonorrhea which has been observed since 1954 has been replaced by an increase from 7,314 cases in 1958 to 8,194 cases in 1959. Of these more than one half occurred in Copenhagen. In 1959 94 cases of acquired syphilis were notified, hereof 57 in Copenhagen. The total number of cases of this disease was in 1958 only 55. Thus the venereal diseases seem to be increasing now after the great decrease during the postwar period.

The distribution of notified cases by age, shown in Table 3, indicates that the epidemic morbidity has been increasing from 1958 to 1959 in all age

From the National Health Service, Statistical Section.
Head: Marie Lindhardt.

Table 2.
The Epidemic Morbidity in Denmark 1959 and 1958.

	Reported cases		per 100,000 pop.	
	1959	1958	1959	1958
Typhoid fever	11	12	0.2	0.3
Paratyphoid fever	35	15	0.8	0.3
Epidemic cerebrospinal meningitis	129	132	2.8	2.9
Acute anterior poliomyelitis, total	27	94	0.6	2.2
—, paralytic	11	66	0.2	1.6
Epidemic cerebrospinal meningitis	33	21	0.7	0.5
Dysentery	40	64	0.9	1.4
Intermittent fever, originating in Denmark	—	—	—	—
—, outside Denmark	5	15	0.1	0.3
Diphtheria	—	—	—	—
Scarlet fever	5,234	2,441	115.1	54.1
Puerperal fever	11	18	1.4 ²⁾	2.4 ²⁾
Pemphigus neonatorum ¹⁾	107	174	14.5 ³⁾	23.3 ³⁾
Tetanus neonatorum ¹⁾	10	12	1.4 ³⁾	1.6 ³⁾
Measles	43,608	24,661	959.5	546.2
German measles	7,166	6,201	157.7	137.4
Chicken-pox	26,283	18,142	580.5	401.8
Whooping-cough	19,279	13,888	424.2	307.6
Mumps	9,468	9,673	208.3	214.3
Influenza	367,553	167,144	8,087.0	3,702.0
Angina and tonsillitis	256,771	207,485	5,649.5	4,595.4
Tracheobronchitis	113,879	122,303	2,505.6	2,708.8
Bronchopneumonia	48,403	49,657	1,065.0	1,099.8
Lobar pneumonia	5,017	4,909	110.4	108.7
Cholera and enteritis	68,918	65,761	1,516.3	1,456.5
Epidemic hepatitis	1,757	2,539	38.7	56.2
Rheumatic fever	897	856	19.7	18.9
Erysipelas	3,298	2,645	72.6	58.6
Gonorrhoea	8,194	7,314	180.3	162.0
Soft chancre, not previously diagnosed	9	10	0.2	0.2
Acquired syphilis, not previously diagnosed	94	55	2.1	1.2
Congenital syphilis, not previously diagnosed	3	4	0.1	0.1
Lymphogranuloma inguinale	2	15	0.0	0.3
Delirium tremens	31	41	0.7	0.9
Scabies	1,692	2,011	37.2	44.5

¹⁾ Under one month. ²⁾ per 10,000 parturients. ³⁾ per 10,000 live-born.

groups, and heaviest for the age groups 15—64 and 65 years and over.

The main results of an investigation of the seasonal variations of influenza, acute pulmonary diseases and angina tonsillaris, and of the impact of influenza morbidity on total mortality are given below.

The investigation is based on the figures for the two 5-year periods 1916—20 and 1954—58, shown in Table 4. The mortality figures for the

individual diseases are lacking for the period 1916—20 because the cause-of-death statistics at this time comprised the towns only.

The seasonal variations can be studied in Figs. I—IV.

Fig. I shows that the morbidity curves for tracheo-bronchitis and pneumonia during the years 1954—58 have had a parallel course with a maximum during wintertime. There is, however, in 1957 a second maximum in autumn, at the time of the Asian Flu. The curve for angina tonsillaris shows the same tendency, but the variations are much smaller. The influenza curve shows four epidemic peaks, three in springtime and one, the Asian Flu, in autumn. There seems to be a minor increase in the number of reported cases of pneumonia during influenza epidemics, and sometimes also more cases of tracheo-bronchitis are reported, probably because more people are seen by the doctors during influenza epidemics.

The curves for tracheo-bronchitis and influenza are following each other closely between the influenza epidemics, but it must be assumed that the cases reported as influenza during these intervals are in fact some kind of catarrhal fever.

Table 3.
Notifiable Diseases According to Age 1959 and 1958.

Age	Reported cases 1959	per 1,000 population	
		1959	1958
Under 1 year	43,660	591	524
1—4 years	185,198	628	505
5—14 »	251,213	314	228
15—64 » males	215,305	150	101
15—64 » females	214,199	146	97
65 years and over, males ..	34,362	157	109
65 years and over, females ..	34,002	134	95
Total	977,939	215	155

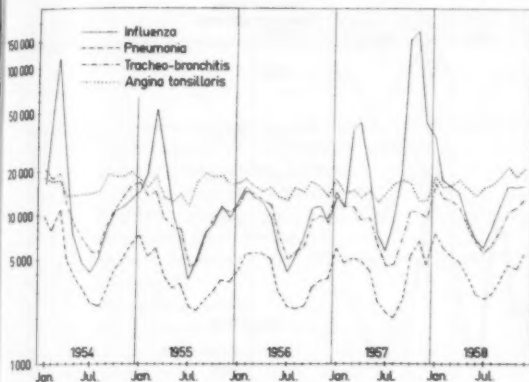


Fig. I.

Notified Cases of Influenza, Acute Pulmonary Diseases and Angina Tonsillaritis. By Months. 1954-1958.

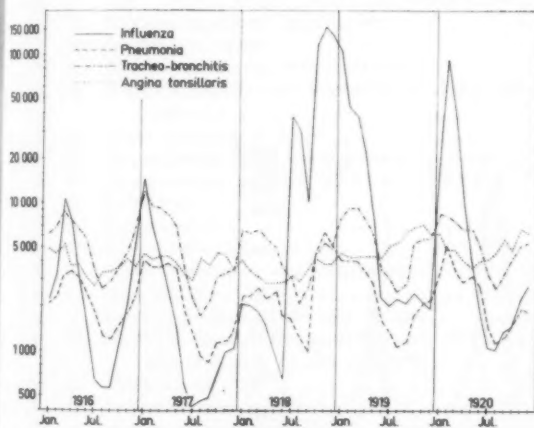


Fig. II.

Notified Cases of Influenza, Acute Pulmonary Diseases and Angina Tonsillaritis. By Months. 1916-1920.

Table 4.

Reported Cases of and Deaths from Influenza, Acute Pulmonary Diseases and Angina Tonsillaritis, and total Deaths in the Years 1916-20 and 1954-58.

	Reported cases of					Deaths from					Total deaths
	Influenza	Broncho-pneumonia	Lobar pneumonia	Tracheo-bronchitis	Angina tonsillaritis	Influenza	Broncho-pneumonia	Lobar pneumonia	Tracheo-bronchitis	Angina tonsillaritis	
1916	39,028	19,641	7,118	65,638	46,692	...	...	...	...	...	39,265
17	34,877	20,062	5,454	64,376	48,021	...	...	...	...	...	39,224
18	496,755	24,618	9,403	56,347	40,796	...	...	...	...	...	39,038
19	236,215	24,150	6,596	68,936	63,346	...	...	...	...	...	39,590
20	175,736	23,561	6,144	66,366	60,869	...	...	...	...	...	39,841
1954	256,371	58,477	6,283	143,343	197,747	397	839	156	86	10	39,885
55	175,616	41,914	4,773	117,589	192,436	101	728	129	85	11	38,791
56	115,203	42,197	4,947	117,635	182,700	42	664	131	66	8	39,590
57	544,613	47,086	4,744	109,839	178,444	435	741	140	70	6	41,730
58	167,144	49,657	4,909	122,303	207,485	119	723	140	59	8	41,560

Table 5.

Deaths per 1,000 Population by Age and Sex. 1959 and 1921.

	1959		1921	
	M	F	M	F
Under 1 year	25.8	18.9	87.9	67.2
1-4 years	1.0	0.9	5.6	4.4
5-14 »	0.4	0.3	1.7	1.7
15-24 »	1.0	0.4	2.9	2.7
25-34 »	1.2	0.9	3.5	3.7
35-44 »	2.3	1.8	4.4	5.4
45-54 »	5.7	4.3	8.7	8.6
55-64 »	15.4	10.1	18.2	17.1
65 years and over	64.8	56.9	70.4	70.8
Total	9.8	8.8	11.2	11.2

Fig. II shows the morbidity for the same four diseases in 1916-20. The curves have much the same shape as in Fig. I, but the level is lower than in 1954-58, due to the fact that people now attend their doctor more frequently than before, partly because of better opportunity to do so, and partly because of the increasing demand for medical certificates in case of absence from work. There were 5 epidemics of influenza during this 5-year period, including the great Spanish Flu in 1918-19 and the distinct summer epidemic in 1918. The clinical picture of the latter epidemic was, however, so different from the usual one that epidemiologists now doubt that it was really an epidemic of influenza.

Fig. III shows that the variations in mortality from pneumonia and influenza are similar to those in morbidity during the period 1954-58. As mentioned above the mortality figures for 1916-20 are not available for the whole country, but it is known that the Spanish Flu caused a substantial rise in mortality from influenza in the towns.

The impact of influenza on total mortality appears from Fig. IV. As will be seen, an epidemic of influenza nearly always causes an increase in total mortality, but the correlation was greater

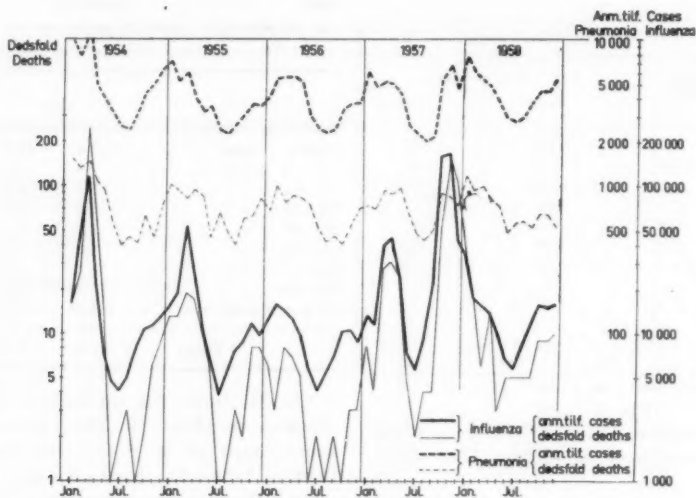


Fig. III.

Anmeldte tilfælde og dødsfald af influenza og lungebetændelse efter måneder. 1954—1958.

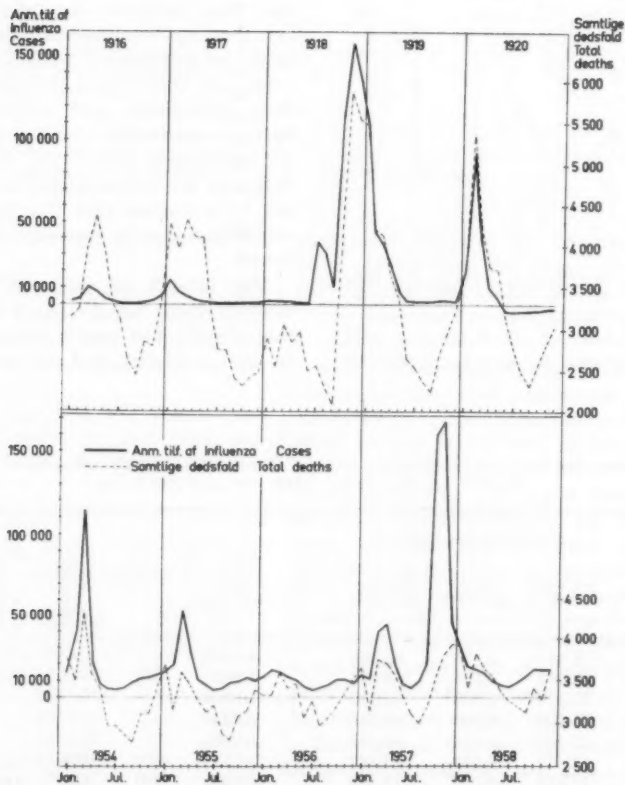


Fig. IV.

Anmeldte tilfælde af influenza og samtlige dødsfald efter måneder 1916—1920 og 1954—1958.

Table 6.
Causes of Death in Denmark 1959 and 1958. Abbreviated List (B).

		1959			1950			per 100,000 pop. 1959			1950
		M	F	Total	Total	M	F	Total	Total		
B 1	Tuberculosis of respiratory system	94	65	159	193	4.2	2.8	3.5	4.3		
B 2	Tuberculosis, other forms	13	8	21	14	0.6	0.4	0.5	0.3		
B 3	Syphilis and its sequelae	27	20	47	43	1.2	0.9	1.0	1.0		
B 4	Typhoid fever	—	—	—	—	—	—	—	—		
B 6	Dysentery, all forms	—	—	—	1	—	—	—	0.0		
B 7	Scarlet fever and streptococcal sore throat ..	—	1	1	—	—	0.0	0.0	—		
B 8	Diphtheria	—	—	—	—	—	—	—	—		
B 9	Whooping cough	3	4	7	3	0.1	0.2	0.2	0.1		
B 10	Meningococcal infections	9	2	11	2	0.4	0.1	0.2	0.0		
B 12	Acute poliomyelitis	—	1	1	1	—	0.0	0.0	0.0		
B 14	Measles	3	3	6	2	0.1	0.1	0.1	0.0		
B 17	All other diseases classified as infectious and parasitic	52	65	117	120	2.3	2.8	2.6	2.7		
B 18	Malign. neoplasms, incl. neoplasms of lymph. and haematopoietic tissues	4,887	4,724	9,611	9,100	216.7	206.1	211.3	201.6		
B 19	Benign and unspecified neoplasms	164	153	317	348	7.3	6.7	7.0	7.7		
B 20	Diabetes mellitus	139	166	305	260	6.2	7.2	6.7	5.8		
B 21	Anæmias	29	41	70	81	1.3	1.8	1.5	1.8		
B 22	Vasc. lesions affect. central nervous system ..	2,431	2,841	5,272	5,375	107.8	124.0	115.9	119.0		
B 23	Nonmeningococcal meningitis	29	16	45	40	1.3	0.7	1.0	0.9		
B 24	Rheumatic fever	13	8	21	12	0.6	0.4	0.5	0.3		
B 25	Chronic rheumatic heart disease	93	192	285	289	4.1	8.4	6.3	6.4		
B 26	Arteriosclerotic and degenerative heart dis- ease	5,611	4,135	9,746	10,430	248.8	180.4	214.4	231.0		
B 27	Other diseases of heart	1,064	880	1,944	2,179	47.2	38.4	42.8	48.3		
B 28	Hypertension with heart disease	268	495	763	743	11.9	21.6	16.8	16.5		
B 29	Hypertension without mention of heart	56	65	121	116	2.5	2.8	2.7	2.6		
B 30	Influenza	268	314	582	119	11.9	13.7	12.8	2.6		
B 31	Pneumonia	534	541	1,075	831	23.7	23.6	23.6	18.4		
B 32	Bronchitis	180	108	288	225	8.0	4.7	6.3	5.0		
B 33	Ulcer of stomach and duodenum	185	90	275	263	8.2	3.9	6.0	5.8		
B 34	Appendicitis	55	35	90	94	2.4	1.5	2.0	1.9		
B 35	Intestinal obstruction and hernia	150	143	293	294	6.7	6.2	6.4	6.5		
B 36	Gastritis, duodenitis, enteritis and colitis, ex- cept diarrhoe of the newborn	90	112	202	151	4.0	4.9	4.4	3.3		
B 37	Cirrhosis of liver	149	233	382	338	6.6	10.2	8.4	7.5		
B 38	Nephritis and nephrosis	117	125	242	259	5.2	5.5	5.3	5.7		
B 39	Hyperplasia of prostate	536	...	536	574	23.8	...	11.8	12.7		
B 40	Complications of pregnancy, childbirth and the puerperium .....	...	32	32	33	...	1.4	0.7	0.7	
B 41	Congenital malformations	256	222	478	447	11.4	9.7	10.5	9.9		
B 42	Birth injuries, postnatal asphyxia and atelec- tasis	307	199	506	500	13.6	8.7	11.1	11.1		
B 43	Infections of the newborn	15	11	26	46	0.7	0.5	0.6	1.0		
B 44	Other diseases peculiar to early infancy, and immaturity unqualified	277	180	457	474	12.3	7.9	10.1	10.5		
B 45	Senility without mention of psychosis, ill- defined and unknown causes	292	328	620	515	13.0	14.3	13.6	11.4		
B 46	All other diseases	1,789	2,361	4,150	4,084	79.3	103.0	91.3	90.5		
BN 47	Fractures, head injuries and internal injuries	1,002	733	1,735	1,632	44.4	32.0	38.2	36.2		
BN 48	Burns	20	42	62	33	0.9	1.8	1.4	0.7		
BN 49	Effects of poisons	371	236	607	681	16.5	10.3	13.4	15.1		
BN 50	All other injuries	461	190	651	615	20.4	8.3	14.3	13.6		
Total		22,039	20,120	42,159	41,560	977.4	877.9	927.3	920.4		
Alternative classification of deaths from accidents, poisoning, and violence (BN 47 — BN 50) according to external cause:											
BE 47	Motor vehicle accidents	609	198	807	658	27.0	8.6	17.4	14.6		
BE 48	All other accidents	587	683	1,270	1,319	26.0	29.8	27.9	29.2		
BE 49	Suicide and self-inflicted injury	647	309	956	957	28.7	13.5	21.0	21.2		
BE 50	Homicide and operations of war	11	11	22	27	0.5	0.5	0.5	0.6		

in 1916-20 than in 1954-58. The reason why not only influenza mortality but total mortality is influenced by the influenza morbidity is that many people, suffering from some chronic condition, lack sufficient strength to pull through an attack of influenza, and these deaths will often be registered under the chronic condition.

As shown in Table 1 the crude mortality rate was practically unchanged from 1958 to 1959, 9.2 and 9.3 per 1,000 respectively. It will be seen from Table 5 that the decrease in mortality rate since 1921 has been heavier for females than for males, and more pronounced in the younger age groups.

Also the infant mortality rate has been almost the same in 1958 and 1959 the rate being 25.2, 24.9, 23.4, 22.4 and 22.5 per 1,000 live born during the period 1955-59.

From Table 6 will be seen that the tuberculosis mortality has again decreased a little after the slight increase in 1958. The mortality from respiratory tuberculosis was in 1959 3.5 per 100,000 population as against 4.3 in 1958. The mortality from extrapulmonary tuberculosis increased, however, from 0.3 to 0.5 per 100,000, resulting in a mortality rate for all forms of tuberculosis of 4.0 against 4.6 in 1958. Malignant neoplasms, and arteriosclerotic and degenerative heart diseases are the two leading causes of death and make up 46 per cent of all deaths. Deaths caused by accidents amount to 4.9 per cent of all deaths. It should be borne in mind, however, that this group includes deaths caused by fall and stumbling, even if the death did not occur until some time after the accident, as is often the case in the older age groups.

A considerable increase in deaths caused by traffic accidents was reported in 1959, whereas deaths caused by poisoning were decreasing. As an effect of the unusually warm summer in 1959 the number of deaths from bathing accidents increased from 25 in 1958 to 33 in 1959. Altogether the total number of deaths increased slightly.

Table 7.
Respiratory Tuberculosis by Age and Sex 1958.

	Notified cases		Known cases Dec. 31st 1958	
	M	F	M	F
0-4 years	37	31	108	83
5-14 »	33	40	223	238
15-24 »	37	61	292	399
25-44 »	178	169	1,998	2,379
45-64 »	212	76	1,727	1,043
65 years and over	99	80	610	425
Total	596	457	4,958	4,567

Cancer of the lung caused in 1959 840 male deaths and 159 deaths among women, against 681 and 140 respectively in 1958. The mortality rate per 100,000 population for this disease was in 1959 37.3 and 6.9 for the two sexes or 22.0 for both sexes combined, against 18.3 in 1958. More deaths are now caused by cancer of the lung than by such causes as "motor vehicle accidents" or "suicide".

The number of suicides was the same in 1958 and 1959, namely 957 and 956 respectively, and the mortality rate is now 21.0 per 100,000 population, the lowest rate recorded since 1943. There has been a downward trend in the suicide rate since 1953.

The rate of notified cases of respiratory tuberculosis was slightly lower in 1959 than in 1958, namely 22.2 per 100,000 population, against 23.3 in 1958, the actual number of cases being 1,008, as against 1,053 in 1958. The number of known cases of respiratory tuberculosis at the end of 1958 was 9,525 or 211 per 100,000 population. The age distribution of known cases at the end of the year is shown in Table 7. 78.5 per cent of all notified cases were bacillary as against 79.7 per cent in 1957. 176 cases of extrapulmonary tuberculosis or 3.9 per 100,000 were notified in 1958, against 198 or 4.4 per 100,000 in 1957. There were 105 chest clinics in Denmark in 1958. 915,122

Table 8.
Number of Visits to Physicians and Midwives According to Act Concerning Pregnancy Hygiene.

	1958/59	1957/58	1951/56 average	1946/51 average	1946/47
1st visit to physician	72,995	73,066	71,482	69,622	71,990
Utilization (i.e. 1st visit in per cent of live-born children)	98	97	93	80	75
2nd and 3rd visit to physician	105 ¹⁾ 97 ²⁾	102 ¹⁾ 94 ²⁾	103 ¹⁾ 85 ²⁾	90 ¹⁾ 72 ²⁾	83 ¹⁾ 65 ²⁾
Utilization (i.e. 2nd and 3rd visit in per cent of 1st visit)	75 ¹⁾ 75 ²⁾	77 ¹⁾ 75 ²⁾	72 ¹⁾ 71 ²⁾	72 ¹⁾ 64 ²⁾	71 ¹⁾ 54 ²⁾
Visits to midwives (maximum 7)	308,367	307,274	287,321	266,581	260,533
Utilization (i.e. visits to midwives in per cent of 1st visit to physicians)	60	60	57	55	52
	68 ¹⁾ 55 ²⁾	67 ¹⁾ 55 ²⁾	64 ¹⁾ 52 ²⁾	63 ¹⁾ 47 ²⁾	62 ¹⁾ 41 ²⁾
Number of live-born children in calendar year	74,700	75,300	77,000	87,140	96,100

1) Towns. 2) Rural districts.

persons were examined, 1,335,691 consultations and 50,725 BCG-vaccinations were given.

According to law, pregnant women can have 10 examinations free of charge, 3 by physician and 7 by midwife. In 1958/59 the number of visits to physicians and midwives were 182,175 and 308,367 respectively. Table 8 shows the utilization rate during later years in rural and urban areas. The rate seems much higher in towns than in rural areas, and sometimes exceeds 100 per cent. The reason for this is that a number of women living in rural areas visit physicians in the towns, and therefore are registered under urban areas.

The number of Public Health Nurses for infants was 366 at the end of 1959 against 362 in 1958. 47,072 infants, or 63.0 per cent of all live-born, were supervised at the end of the year, as against 62.9 per cent in 1957. Only 529, or 1.1 per cent of the homes refused to receive the Public Health Nurse. 790,018 visits were paid.

At the end of the year 1959, dental services were given to school children by 210 dental clinics, serving 270,000 children. 414 dentists served as school-dentists, hereof 103 in the capital, 179 in the provincial towns and 132 in rural areas. In a few municipalities dental services were rendered by practising dentists in their office.

A survey of the number of beds in hospitals and other institutions for care of the sick is given in Table 9. There were 27,285 beds in 145 hospitals,

and 19,721 in other institutions. The total number of beds amounts to 10.41 per 1,000 population.

Table 10 gives information about cases treated in the hospitals in 1950, 1957 and 1958. The number has been increasing, and was 121 per 1,000 population in 1958 as against 119 and 106 in 1957 and 1950 respectively. The number of cases, 551,251, exceeds the number of patients, because sometimes more than one diagnosis is given. A change in the relative frequency of the diagnosis groups has taken place during later years. Some groups are now more frequent than before, e. g. diseases of the circulatory system, diseases of pregnancy and childbirth, neoplasms and traumatic injuries. There are on the other hand relatively fewer cases of skin diseases and infectious diseases, including V. D.

A total of 526,804 patients were treated in the hospitals in 1958. The number of patient-days was 8.9 million, and the average length of stay 17 days.

The activity of the special hospital departments is shown in Table 11. These departments with a total of 21,603 beds, treated 417,933 patients. The length of stay per patient was roughly the same in 1957 and 1958, viz., for surgical departments 15 days, and for medical departments 21 days in both years.

The working expenses of the public hospitals in 1957/58 were 417.7 million Danish crowns, against 388.4 million in 1956/57 (see Table 12).

Table 9.
Beds in Hospitals and Other Institutions for Treatment of the Sick. December 31st 1958.

	No. of institutions	No. of departments	No. of beds.	
			total	per 1,000 population
1. Hospitals:				
Hospitals with special departments	74	270	21,566	4.78
Hospitals mostly with mixed departments	71	73	5,719	1.27
All hospitals	145	343	27,285	6.04
2. Other institutions:				
Infirmaries in old-age homes etc.	63	—	3,796	0.84
Private clinics	13	—	235	0.05
Municipal maternity hospitals	3	—	72	0.02
Nursing institutions	47	—	2,854	0.63
Tuberculosis hospitals	31	—	2,165	0.48
Mental hospitals	11	—	9,611 ¹⁾	2.13
Hospitals for epileptics	3	—	988	0.22
Total	171	—	19,721	4.37
All hospitals and institutions	316	—	47,006	10.41
In addition accommodation in:				
Asylums for feeble-minded			7,685 ²⁾	1.70
Institutions for the blind			370	0.08
Institutions for deaf-mutes			633	0.14

See table 11 concerning activity of special departments.

¹⁾ In addition accommodation for 885 patients in family care.

²⁾ In addition accommodation for 7,686 patients in family care.

Table 10.
Survey of Cases Admitted to Danish General Hospitals, 1958, 1957 and 1950.

	Main diagnoses			per 1,000 diagnoses		
	1958	1957	1950	1958	1957	1950
1 Respiratory diseases	27,173	25,263	23,441	49.3	47.4	52.0
2 Senile diseases	680	634	776	1.2	1.2	1.7
3 Diseases of musculo-skeletal system	25,254	24,175	20,195	45.8	45.4	44.8
4 Diseases of the blood and blood-forming organs ..	5,440	4,083	3,036	9.9	7.7	6.7
5 Endocrine diseases	18,269	17,748	12,158	33.1	33.3	27.0
6 Diseases of the digestive system	82,855	79,466	70,702	150.3	149.2	156.8
7a Poisonings, acute	5,060	4,944	3,276	9.2	9.3	7.3
7b Poisonings, chronic	1,489	1,413	1,009	2.7	2.7	2.2
8 Skin diseases	14,736	14,544	16,004	26.7	27.3	35.5
9 Infectious diseases*)	17,219	18,660	26,501	31.2	35.0	58.8
10 Diseases of the circulatory system	39,413	37,039	24,752	71.5	69.5	54.9
11a Diseases of the genitals, male (excl. venerea) ..	7,659	7,995	5,705	13.9	15.0	12.7
11b Diseases of the genitals, female (excl. venerea) ..	37,228	36,596	28,694	67.5	68.7	63.6
12 Malformations, congenital	3,832	3,733	2,480	7.0	7.0	5.5
13 Organic diseases of the nervous system	18,285	17,431	12,778	33.2	32.7	28.3
14 Functional diseases of the nervous system	23,078	22,621	22,285	41.9	42.5	49.4
15 Infantile diseases	3,157	3,126	2,272	5.7	5.9	5.0
16 Diseases of the urinary system	16,140	14,746	10,308	29.3	27.7	22.9
17 Diseases of pregnancy and childbirth	31,508	31,958	26,000	57.2	60.0	57.7
18 Normal pregnancy and birth	47,751	47,160	43,024	86.6	88.6	95.4
19a Tumours, malignant	21,785	20,913	15,237	39.5	39.3	33.8
19b Tumours, benign	14,406	13,978	10,195	26.1	26.2	22.6
20 Traumatic injuries	56,129	53,549	37,823	101.8	100.5	83.9
21 Eye diseases	6,665	6,967	6,201	12.1	13.1	13.8
22 Ear diseases	8,370	7,542	10,661	15.2	14.2	23.6
23 Observations and other uncertain cases	17,670	16,308	15,368	32.1	30.6	34.1
Total	551,251	532,592	450,881	1000.0	1000.0	1000.0
per 1,000 population	121	119	106	—	—	—
*) hereof venereal diseases	692	819	1,415	1.3	1.5	3.1

Table 11.
Number of beds, Admissions and Average Length of
Stay in Special Departments in Danish Hospitals
1957/58.

Departments	No. of depart- ments	No. of beds	Admis- sions	Average length of stay in days	
				1958	1957
Medical	61	6,666	109,007	20	20
Surgical	60	6,914	163,298	15	15
Neurological	8	585	9,043	21	21
Brain-surgical	4	188	4,940	16	16
Chest-surgical	2	119	1,489	24	25
Orthopaedic	8	583	8,954	21	21
Gynaecological	16	1,152	32,687	12	12
Maternity	6	412	12,584	10	10
Otolaryngological	27	794	23,500	10	11
Ophthalmological	21	336	5,848	14	15
Paediatric	13	947	12,973	22	23
Dermato-venereal	7	474	5,380	27	26
Radium	3	317	4,355	24	25
X-ray	2	37	332	28	38
Physiurgic	6	153	1,082	28	31
Epidemic	4	568	7,959	19	18
Psychiatric	7	660	11,451	21	20
Tuberculosis	17	698	3,051	63	62
Total 1958	272	21,603	417,933	—	—
Total 1957	257	20,473	402,814	—	—

Table 12.

*Working Expenses of all Public Hospitals 1957/58.
In Danish crowns (1 D.cr. = 1 sh. = 0.14 U.S.\$).*

	Total in mill. D. cr.	In per cent of total:		
		Wages	Board	Other expenses
County and municipal hospitals	371.2	61.3	8.1	30.6
State hospitals	46.5	67.0	5.2	27.8
Total 1957/58	417.7	62.0	7.8	30.2
Total 1956/57	388.4	61.0	8.4	30.6

The largest entry was wages with 62 per cent of the total.

The average expense per bed-day in 1957/58 was 52.81 Danish crowns, against 49.22 Danish

crowns in 1956/57, and the expense per board-day was 2.69 Danish crowns against 2.71 in the previous year. The total expense per capita was 92.50 Danish crowns in 1957/58 and 86.54 in 1956/57.

The total number of physicians employed in the public hospitals in 1958 was 1,895, hereof 1,640 in city- and county hospitals. 7,560 registered nurses were working in the public hospitals, of whom 6,588 were in city- and county hospitals. The number of student nurses was 4,134 in public hospitals, hereof 3,957 in city- and county hospitals. In all hospitals, public as well as private, there were 2,161 physicians, 8,598 registered nurses and 4,418 student nurses. A total of 2,466 physicians were employed by all curative institutions; of these 633 were chief physicians.

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